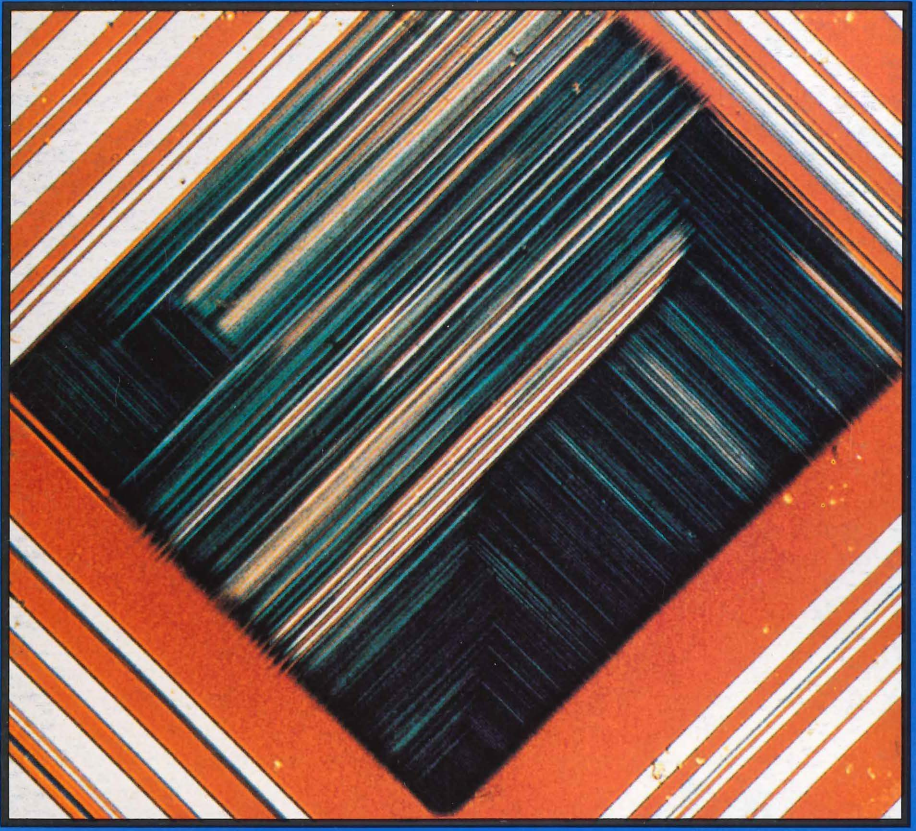
VAMAS



BULLETIN NO. 17
January 1994

Versailles Project on Advanced Materials and Standards
• Canada • France • Germany • Italy • Japan • UK • USA • EC •

VAMAS

The Versailles Project on Advanced Materials and Standards (VAMAS) supports trade in high technology products through international collaborative projects aimed at providing the technical basis for drafting codes of practice and specifications for advanced materials. The scope of the collaboration embraces all agreed aspects of enabling science and technology - databases, test methods, design methods, and materials technology - which are required as a precursor to the drafting of standards for advanced materials. VAMAS activity emphasizes collaboration on pre-standards measurement research, intercomparison of test results, and consolidation of existing views on priorities for standardization action. Through this activity, VAMAS fosters the development of internationally acceptable standards for advanced materials by the various existing standards agencies.

ISSN 1016-2178

Cover: Photograph of a rectangular single crystal of the high temperature ceramic superconductor $YBa_2Cu_3O_{7-x}$ showing the orthogonal twin structure characteristic of this material.

Photograph courtesy of National Institute of Standards & Technology, Gaithersburg, MD, USA

VAMAS

• Table of Contents •

• Foreword •

With the execution of the VAMAS Memorandum of Understanding by France in 1993, the structure, operations, and broad mission of VAMAS was fully implemented for its second five years. The recent introduction of the Co-ordinator system to improve communications between the Steering Committee (SC) and the Technical Working Areas (TWAs) is well underway and, at this early stage, appears successful in its key goal of reducing the time necessary for the initiation of new TWA work projects and participation.

It is with great pleasure that I announce that Mr. Ian Campbell of the British Standards Institute has joined the SC representing the United Kingdom,. Mr. Campbell's strong technical background and close relationship with the IEC should prove to be a major asset for VAMAS in our efforts to strengthen ties to national and international standards-writing organizations.

Some additional changes have been made in the assignment of Steering Committee members as Co-ordinators since the initial assignments in early 1993. These changes result from: the separation of TWA 6 into two new TWAs, TWA 16 on Superconducting Materials and TWA 17 on Cryogenic Structural Materials with two new TWA Chairmen; changes in the leadership of TWA 5, Polymer Composites, and TWA 10, Materials Databanks; and the addition of Mr. Campbell to the SC. The complete, current list of Co-ordinators is found elsewhere in this Bulletin issue (page 5).

In the last issue of the Bulletin, we initiated a new strategy to sharpen the Bulletin focus and further enhance information transfer. First, only TWA summary reports that contain new progress on their work program are included. Second, two new sections, ***Standards Highlights*** and ***Recent VAMAS Outputs*** [reports, archival articles, etc] were initiated to highlight the technical accomplishments of the TWAs and the impact of VAMAS activities on standards development. A number of TWAs are now making regular contributions to these two topics. I want to strongly encourage all TWAs to continue to provide routinely to the VAMAS Secretary information and copies of all draft or approved national or international standards and all reports, articles, etc based on VAMAS efforts.

Harry L. Rook
Chairman

• Standards Highlights •

In its role of providing the technical basis for drafting codes of practice and specifications for advanced materials, VAMAS fosters the development of internationally acceptable standards for advanced materials by the various existing national, regional, and international standards agencies. With the renewal of VAMAS for another five years, a major focus for each Technical Working Area is to strengthen further its ties to the standards-writing community. With the increasing number of concluded pre-standards research projects, it is essential that the results be rapidly transferred to standards-writing organizations. Although not every pre-standards research project produces definitive test results in direct support of a specific standards effort, we continue to see the impact of VAMAS efforts through their recognition in an increasing number of adopted standards.

As part of a plan to provide greater visibility for the technical outputs of the Technical Working Areas (TWAs), Standards Highlights will identify draft or adopted standards documents from national, regional, or international standards bodies that are based all or in part on pre-standards technical outputs from VAMAS TWAs. In the absence of a central standards clearinghouse, VAMAS participants are strongly encouraged to notify the Secretariat of any such adopted standards and to send a copy to the VAMAS Secretary.

Recent draft or adopted standards include:

1] CEN ENV 843-3, ***Mechanical Properties at Room Temperature; Part 3: Determination of Subcritical Crack Growth Parameters from Constant Stressing Rate Flexural Strength Tests,*** CEN TC 184, Advanced Technical Ceramics. VAMAS contributor - TWA 3, Ceramics, G. Quinn, Chairman.

2] CEN ENV 843-4, ***Mechanical Properties at Room Temperature; Part 4: Vickers, Knoop and Rockwell Superficial Hardness Tests,*** CEN TC 184, Advanced Technical Ceramics. VAMAS contributor - TWA 3, Ceramics, G. Quinn, Chairman.

3] CEN ENV 623, ***Methods of Test for Advanced Monolithic Technical Ceramics: General and Textural Properties; Part 3: Determination of Grain Size,*** CEN TC 184, Advanced Technical Ceramics. VAMAS Contributor - TWA 3, Ceramics, G. Quinn, Chairman.

4] ASTM G99-90, ***Standard Test Method for Wear Testing with a Pin-on-Pin Apparatus,*** adopted April 1990, ASTM Committee G2, Wear & Erosion. VAMAS Contributor - TWA 1, Wear Test Methods, E. Santner and S. Jahanmir, Co-Chairmen.

• Feature Article •

VAMAS: PHASE II (1992-1997) STATUS REPORT

J. G. Early
VAMAS Secretary
Materials Science & Engineering Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899, USA

1 Background

Following the Berlin Steering Committee (SC) meeting in 1992, a thematic structure and a SC Co-ordinator system were implemented. The thematic structure for the Technical Working Areas (TWAs) provides a coherent framework for describing the VAMAS technical program to the non-VAMAS world. The central concept of the Co-ordinator system is the delegation by the full SC of specific authority and responsibilities to individual SC members or Co-ordinators who act as the interface between the full SC and the TWA leadership. The TWA chairmen interact directly with their respective Co-ordinators to facilitate TWA programs. The Co-ordinator and TWA Chairman have joint authority to review and approve proposed new work projects while participation by researchers from non-VAMAS countries can be directly approved by the Co-ordinator.

With the extension of the VAMAS MoU (1992-1997) and the adoption of the Co-ordinator system, VAMAS has entered a new era of maturity. When VAMAS started, the SC members and the TWA chairmen were typically the same individuals. With the passage of time, the leadership of almost all of the TWAs has passed to a new generation. Some of the early TWAs have completed their original goals and disbanded while others have identified new challenges and work programs. New TWAs are also being formed to respond to the continuing standards needs for advanced materials. With the increase in TWA outputs and closer ties to national and international standards organizations, the visibility of VAMAS programs as an important contribution to standards has grown. This visibility has re-enforced the importance of program planning at the TWA level to anticipate future needs and to efficiently use the voluntary resources available to VAMAS. As VAMAS has grown both in technical scope and TWA memberships, it has also become more difficult to keep the "human face" on all of the activities and thus it has become more important for the organization's leaders to establish and maintain strong, direct personal interactions.

In response, the SC at its last meeting held at NIST in 1993 decided to schedule a joint planning workshop with all of the TWA leaders immediately prior to the next SC meeting. The Workshop will be held on March 14-15, 1994 at the EC Joint Research Center, Petten, The Netherlands. At this Workshop, each TWA will review its near-term and long-term technical program plans and strategies for accomplishing the program goals for the SC members and the other TWA leaders. In turn, the TWA leaders will be encouraged to raise issues, concerns, questions, etc. directly to the SC for discussion and resolution. Following the Workshop, the SC will convene to review the TWA plans and take action where appropriate. A Workshop summary will be included in the next issue of the Bulletin.

2 Thematic Structure

The programmatic structure for the technical activities is organized around a five theme structure. The TWAs have been grouped under the following themes:

I	METALS AND METAL MATRIX COMPOSITES	TWA 13, TWA 15,	Low Cycle Fatigue Metal Matrix Composites
II	POLYMERS AND POLYMER MATRIX COMPOSITES	TWA 4, TWA 5, TWA 12,	Polymer Blends Polymer Composites Efficient Test Procedures for Polymer Properties
III	CERAMICS AND CERAMIC MATRIX COMPOSITES	TWA 3,	Ceramics
IV	TEST TECHNIQUES (non-material specific)	TWA 1, TWA 2, TWA 7, TWA 8, TWA16, TWA17,	Wear Test Methods Surface Chemical Analysis Bioengineering Materials Hot Salt Corrosion Resistance Superconducting Materials Cryogenic Structural Materials
V	MATERIALS CLASSIFICATION AND DATA	TWA 10, TWA 14,	Materials Databanks Unified Classification System for Advanced Ceramics

3 Co-ordinator System

The SC Co-ordinator/TWA assignments as of February 10, 1994 are as follows:

Co-ordinator	Technical Working Area	
H. Czichos	TWA 1	Wear Test Methods
K. Hossain	TWA 2	Surface Chemical Analysis
J. Takagi	TWA 3	Ceramics
J. Martel	TWA 4	Polymer Blends
C. Bathias	TWA 5	Polymer Composites
P. Giusti	TWA 7	Bioengineering Materials
H. Kröckel	TWA 10	Materials Databanks
G. Sievers	TWA 12	Efficient Test Procedures for Polymer Properties
D. Gould	TWA 13	Low Cycle Fatigue
K. Riley	TWA 14	The Technical Basis for a Unified Classification System for Advanced Ceramics
A. Oguchi	TWA 15	Metal Matrix Composites
I. Campbell	TWA 16	Superconducting Materials
A. Iwahashi	TWA 17	Cryogenic Structural Materials
to be assigned	TWA 8	Hot Salt Corrosion Resistance.

4 VAMAS Bulletin

One element of our strategy to focus greater visibility on VAMAS activities is to highlight the reports, publications, and other outputs of the TWAs. The TWA Chairs are responsible for submitting status or work-in-progress reports on important developments in their various projects and substantive articles on completed projects for the VAMAS Bulletin. The TWA Chairs are also responsible for submitting a one to three page summary or extended abstract for each formal TWA output, including final and interim VAMAS reports, scientific articles or articles on segments of completed projects that are to be published. This extended abstract or summary should be sent to the Secretary and should include: the purpose of the project; summary of results, conclusions, and recommendations; reference to where full report or article will be published; a brief bibliography of recent articles relevant to the VAMAS document; and, if appropriate, a discussion of the next step or phase. Often a summary or extended abstract has already been prepared for the report or archival article and this can be combined with any report recommendations and used for the VAMAS Bulletin. When finally published, two copies of the complete report or article should be sent to the Secretary. In the previous issue of the Bulletin, we initiated the ***Recent VAMAS Outputs*** feature with two report summaries. This issue contains summaries of six recent TWA outputs from five TWAs. This is an excellent response and I encourage the TWAs to continue to make this information available to the Secretary in a timely manner.

• Feature Article •

NEW TECHNICAL WORKING AREA
TWA 16 Superconducting Materials

Dr. Hitoshi Wada
National Research Institute for Metals
Tsukuba, Ibaraki 305, Japan
Tel: +81 298 53 1072
Fax: +81 298 53 1005/1010

In the mid-1980s, VAMAS established a Technical Working Area (TWA 6) on Superconducting and Cryogenic Structural Materials. This TWA initially developed its program around the cryogenic temperature regime, including both low-temperature superconducting materials and structural materials for use in cryogenic applications. With the initial discovery of a class of materials exhibiting high-temperature superconductivity, a world-wide explosion of research and development efforts has occurred. The difficult challenges of characterizing the properties and performance of these new materials often has been revealed by the inability to reproduce property measurements which, in turn, has inhibited the analysis and interpretation of the materials' intrinsic behavior. By 1993, the continued growth in the need for pre-standards research on the new, high-temperature superconductors resulted in the decision by the VAMAS Steering Committee to establish a separate TWA on superconductivity by splitting TWA 6 into two TWAs, TWA 16 on Superconducting Materials and TWA 17 on Cryogenic Structural Materials. This article highlights the significant pre-standards research contributions to superconductivity from TWA 6 and the future focus of TWA 16.

1 Introduction

Superconductivity is believed to be one of the keys to future progress in science and technology. It was first found in mercury in 1911 by Kamerlingh Onnes of the Netherlands. In the ensuing 70 years, a great number of materials were investigated and found to be superconducting (now termed as metallic or low-temperature superconductors). Many scientists had made predictions of high-temperature superconductivity[1], but none of these materials had critical temperatures at which they lose electrical resistivity higher than 25 kelvin. However, a dramatic breakthrough came in 1986 when J. G. Bednorz and K. A. Mueller in Switzerland reported an occurrence of superconductivity above 30 kelvin in copper-based oxides with modified Perovskite crystal structures.[2] This triggered a world-wide rush to explore high-temperature superconducting oxides in the following years. Soon, superconductivity was found to occur above liquid nitrogen temperature[3] and even far beyond 100 kelvin[4]. In parallel with these investigations, efforts have been made in fabricating these new materials into conductors, and, to date, conductors up to one kilometer long and magnets of small sizes have been realized.[5,6]

High-temperature oxide superconductors have properties that are potentially superior to those of low-temperature superconductors. For certain high-temperature oxide superconductors, critical fields indicative of the potential to induce magnetic fields are expected to be well beyond 100 tesla, while the maximum values reported on low-temperature superconductors are below 60 tesla. However, their more complicated natures (superconducting properties, crystal structures, morphologies, etc) impose measurement requirements which in many respects are beyond those for low-temperature superconductors.

Meanwhile, remarkable progress has been accomplished in the field of cryotechnology and refrigeration down to 20 kelvin or below is now possible without using a liquid cryogen.[7] This should greatly encourage use of high-temperature oxide superconductors for a variety of applications. In fact, a superconducting magnet using a high-temperature oxide superconductor was successfully operated at 21 kelvin by this cryogen-free refrigeration method.

2 Background

Applications of superconductivity have been pursued frequently in both national and international efforts using mainly NbTi superconductors which show stable superconducting properties. Typical dc applications may be found in the field of nuclear fusion or high energy particle physics. World-wide commercial applications in medicine or life sciences include MRI imaging. As these and other applications matured, a strong demand developed for superconductors with properties superior to NbTi. One promising candidate, Nb_3Sn, is much more sensitive to external disturbances, such as mechanical strain, so that determination of superconducting properties is more difficult than with NbTi. On the other hand, the use of NbTi for ac current applications has developed rapidly. Under these circumstances, it was considered urgent to develop reliable standard measurement methods to measure superconducting properties in order to further encourage the use of these materials for industrial applications.

In response to the need to develop measurement methodologies, VAMAS established TWA 6 and the first meeting was held in April 1986 with 19 researchers present at KfK, Karlsruhe in Germany. The initial projects were to develop standard measurement methods for dc critical current in Nb_3Sn and ac losses in NbTi superconductors. The TWA implemented two interlaboratory measurement comparisons on each of these two properties. The last intercomparison, completed in the summer of 1993, was the measurement of the critical field of a NbTi superconductor. The final results will appear as supplemental volumes of an international scientific journal.

In accordance with the establishment of liaison relationships of VAMAS with the IEC, TWA 6 has been working with the IEC TC 90 on the international standard for dc critical current measurement in Nb_3Sn superconductors. The first draft of a standard was based entirely on TWA 6's results and will be transferred to the IEC.

Shortly after TWA 6 started its activities, the discovery of high-temperature superconductivity was reported. Since then, most of the TWA 6 members have followed closely the development of high-temperature superconductors. These new materials are entering applications, and many of the TWA members are conducting their own research programs on these materials. Thus, when a new project entitled "Characterization and Evaluation of High-Temperature Oxide Superconductors" was proposed at the 10th TWA meeting in Albuquerque, NM, USA, in July 1993, it was strongly endorsed by all the participants in the meeting. In October 1993, a preparatory project meeting for European members was held at Goettingen, Germany.

3 Purpose and Objectives

Recognizing the shift in focus from low-temperature to high-temperature superconductivity and the substantial increase in high-temperature superconductivity research activity, the VAMAS Steering Committee approved the separation of TWA 6 into TWA 16 on Superconducting Materials, and TWA 17 on Cryogenic Structural Materials, at its 16th meeting in April 1993. The focus of TWA 16 activities is the characterization and evaluation of high-temperature oxide superconductors based on the following objectives:

(1) establishment of reliable critical current measurement methods
(2) establishment of reliable critical temperature measurement methods
(3) establishment of reliable critical field measurement methods
(4) evaluation of superconducting critical surface
(5) evaluation of related physical properties
(6) reviews of theoretical approaches, and
(7) terminology.

At the Albuquerque meeting it was agreed that objective (1) should be the primary target while the other objectives are considered complimentary. This project should eventually provide some very useful criteria for critical properties of high-temperature oxide superconductors. Such criteria would form a baseline for international standardization of these materials.

4 Plans

Basic Strategy

The basic strategy was established through discussion at Albuquerque and Goettingen. Although high-temperature oxide superconductors are still quite new and under development, a great deal of experience and expertise already exists from studies of low-temperature superconductors. The TWA's pre-standardization efforts should be complemented by basic research in high-temperature oxide superconductors. The specific TWA activities are classified in two categories:

(1) Interlaboratory measurement comparisons or round robin tests (RRTs) on critical current, where intercomparisons using common samples are conducted using different measurement methods as well as intercomparisons with a specified measurement method; and

(2) Complementary studies including:

a strain effect measurements
b. critical temperature and critical field measurements
c. determination of superconducting critical surface
d. measurements of related physical properties
e. very high magnetic field measurement
f. review of existing theories, and
g. terminology.

These studies are assumed to be individual-based. However, some may be carried out as interlaboratory comparisons when necessary.

General Schedule

The project shall proceed in accordance with the following schedule.

Phase 1:

(1) The 1st local interlaboratory measurement comparison on critical current within each of Europe, USA, and Japan, using common oxide superconductor test samples supplied through designated local coordinators;
(2) Local interlaboratory measurement comparisons on critical current within each of Europe, USA, and Japan, using superconductor simulators recently developed by NIST;
(3) Individual complementary studies.

Phase 2:

(1) The 2nd local interlaboratory measurement comparison on critical current;
(2) Individual complementary studies.

Phase 3:

(1) General interlaboratory measurement comparison on critical current, using common oxide superconductor test samples supplied through designated coordinators;
(2) Individual complementary studies.

Phase 4:

(1) Preparation and publication of TWA report.

The idea of local interlaboratory comparisons is a result of difficulties in getting widely accepted standard oxide superconductors at the moment.

Organization and Operation

The following assignments of responsibilities were agreed to by member research laboratories: TWA office and Japanese local coordinator laboratory - NRIM (National Research Institute for Metals); European local coordinator laboratory - University of Twente; USA local coordinator laboratory - NIST.

Under the leadership of the TWA Chairman, the TWA office makes general plans for interlaboratory comparisons and assignment with respect to complementary studies. It also coordinates the TWA annual meeting; it was agreed among TWA members that the meeting should be held on the occasion of Applied Superconductivity Conference in even number years and International Cryogenic Materials Conference in odd number years. The first TWA 16 meeting will be held in Boston, MA, USA, October 1994. Local coordinators are responsible for planning and implementing local interlaboratory measurement comparisons on critical current. They prepare test samples and publish reports on the interlaboratory comparisons. TWA members implement assigned complementary studies and publish the results in addition to participating in the interlaboratory comparisons.

Recent Publications

Results will be disseminated on every possible occasion including international conferences, such as Applied Superconductivity Conference, Cryogenic Engineering Conference, and through relevant international journals. Efforts will be made to form annually a VAMAS session at one of the above conferences where participants can present their results. Also, summaries of TWA activities will be published in the form of TWA reports which include some recommendations on critical current measurement criteria that are useful for the international standardization of high-temperature oxide superconductors.

Interaction with International Standards Organizations

Interaction with other organizations, such as the IEC and ISO, may be possible under the leadership of the VAMAS Steering Committee.

5 Participation

To date, 27 leading laboratories from 8 different countries have joined this TWA. Participating laboratories and representing researchers are listed in Participants List.

6 Current Activities

Superconductor simulators have been set up for local interlaboratory comparisons and will shortly be delivered to local coordinators. Meanwhile, local coordinators are coordinating respective local interlaboratory comparisons, so that they will be able to report the first results at the coming Applied Superconductivity Conference in Boston where the annual TWA meeting will also be held. The TWA office is considering the assignment of complementary studies.

7 References

1. W. L. McMillan, Phys. Rev., **167**, 331 (1968)
2. J. G. Bednorz and K. A. Mueller, Z. Phys., **B64**, 189 (1986)
3. C. W. Chu et al, Phys. Rev. Lett., **58**, 405, (1987)
4. H. Maeda et al, Jap. J. Appl. Phys., **27**, 209, (1988)
5. H. Kumakura et al, Adv. Superconductivity IV, Springer Verlag, 547, (1992)
6. K. Ohkura et al, Adv. Superconductivity VI, Springer Verlag, in print, (1994)
7. K. Watanabe et al, Jap. J. Appl. Phys., **32**, L488, (1993)

8 Participant List (as of January 1994)

Country	Researcher	Organization
Austria	Prof. H. Kirchmayr	Tech. Univ. Wien (Inst. Exper. Phys.)
	Prof. W. Steiner	Tech. Univ. Wien (Inst. Angw. Tech. Phys.)
	Prof. H. W. Weber	Atominst. Oesterr. Univ.
Belgium	Dr. J. Cornelis	SCK/CEN (observer)
Germany	Dr. W. Goldacker	Kernforschungszentrum Karlsruhe
	Dr. H.-W. Neumuller	Siemens
	Dr. J. Tenbrink	Vacuumschmelze
Italy	Prof. R. Cantelli	Univ. Roma
	Dr. F. Pavese	Inst. Metr. G. Colonnetti
	Dr. S. Zannella	CISE SPA
	Dr. F. Fontana	Univ. Campobasso
	Dr. G. Mascolo	Univ. Cassino
Japan	Prof. K. Funaki	Kyushu Univ.
	Dr. S. Hayashi	Kobe Steel Corp.
	Prof. T. Matsushita	Kyushu Inst. Tech.
	Dr. S. Murase	Toshiba
	Prof. K. Tachikawa	Tokai Univ.
	Dr. H. Wada	NRIM
	Prof. K. Yasohama	Nihon Univ.
Netherlands	Dr. H.H.J. ten Kate	Univ. Twente
UK	Dr. A. M. Campbell	Cambridge Univ.
	Dr. H. Jones	Oxford Univ. (Clarendon Lab)
USA	Dr. W. L. Carter	American Supercond. Corp.
	Dr. E. W. Collings	Battelle
	Dr. L. F. Goodrich	NIST
	Prof. D. Larbalestier	Univ. Wisconsin
	Dr. S. van Sciver	Florida State Univ. (NHMFL)

• Recent VAMAS Outputs •

EXTENDED ABSTRACT

VAMAS Technical Report No. 14
"A Compilation of International Standards for Friction
and Wear Testing of Materials"
P. Blau, Editor
Oak Ridge National Laboratory
Oak Ridge, Tennessee, USA

The purpose of this project was to provide a list and index of internationally-developed standards, practices, and guidelines related to friction and wear testing of materials. It involved the work of national representatives to VAMAS Technical Working Area 1 on "Wear Test Methods." The project was approved by the VAMAS Steering Committee in 1992, pursuant to a proposal submitted by the U.S. representative. The contributions of the national representatives were compiled and indexed to produce this report. Information was provided from Germany, Japan, France, the United Kingdom, and the United States. Other countries such as Canada and Finland participated; however, there were no specific standards for friction and wear testing in those countries. Certain standards from Poland which were available at the time of this project were also included in this compilation for the benefit of the reader.

The author makes no claim that all existing friction and wear standards from the contributing countries are contained within this document. Some of the standards originally obtained had the terms "wear" or "friction" in their titles, but on later examination turned out not to be friction or wear testing standards. For example, the installation of "wear plates" in railroad car couplings was not felt to be in the spirit of this compilation. Likewise, some judgement was exercised with regard to standards dealing with the properties of lubricants, and not all such standards were listed herein. Further, while we endeavored to produce a complete, current listing, it is possible that at the time of publication some of the standards listed here will have been either significantly revised or withdrawn. Therefore, this document should be used only as an informational guide to international standards, and not a regulatory or source document. The reader should contact the relevant standards organizations to obtain the most recently-approved documents.

• Recent VAMAS Outputs •

EXTENDED ABSTRACT

VAMAS Technical Report No. 15
"Classification of Advanced Technical Ceramics"
S. Schneider, Editor
National Institute of Standards and Technology
Gaithersburg, Maryland, USA

As a consequence of modern day technology needs, materials technologies have seen a waning of commodity materials usage in parallel with a commensurate increased demand for engineered materials that perform totally new functions or old functions in much better ways. Accordingly, a wave of new products using advanced materials are appearing with regularity on the marketplace. Among these new materials types, advanced ceramics have emerged as a premier class that has enabled current technologies to be improved, and new technologies possible.

Advanced ceramics are already market entities. With more in the offing, estimates place world markets to be tens of billions of dollars by year 2000. Even so, advanced ceramics have not been generally recognized as a separate materials class, distinct from other types of ceramic materials. Currently standardization systems are out of date and must be adjusted to include advanced ceramics and other new material products. Otherwise every facet of science and technology and associated parts of the economy will devise their own set of advanced ceramic definitions, append various labels and develop tabulation specifications that typically will conflict one to another. This discordant process is already underway.

The standardization issue is complex, but the first need is the development of a classification system for advanced ceramics products that defines what they are, what they are good for, and when statistics or other data are compiled, tells the level of associated activity, element by element. In recognition of this need, VAMAS in 1988 established Technical Work Area No 14 on the classification of advanced ceramics to provide the pre-standards foundation and building block guide for an internationally acceptable system. Three strategic objectives set the directions of the international effort:

1. To identify and assess the issues inherent in developing a classification system for advanced ceramics;

2. To establish a classification structure suitable for international use, including industrial economic statistical indicators, materials and property databases, and products, standards and literature categorizations; and,

3. To develop mechanisms and international institutional links for system implementation.

The objectives were achieved in a work plan that included: an assessment of existing classifications systems and terminology; a worldwide survey of the classification practices and preferences of industry; and, an international workshop to develop a detailed technical basis for the preferred industrial scheme. These activities culminated in the development of a full range classification system for advanced technical ceramics, having the following features:

- Defines "advanced technical ceramics" as "a highly engineered, high performance, predominately non-metallic, inorganic, ceramic material having specific functional attributes". This definition encompasses a diverse range of materials and product classes separated along physical applications like mechanical, thermal, electrical, etc., but excludes commodity products, such as building materials and refractories;

- Identifies and lists 500 different product types as advanced technical ceramics;

- Establishes a comprehensive classification system for advanced technical ceramics that is capable of expansion to accommodate new products or the inclusion of other ceramic classes;

- Provides a non-hierarchical, matrix-type scheme of classification that is accessible by a number of entry and retrieval routes to build relational databases; and,

- Provides a machine readable coding system built upon four independent descriptor fields and corresponding subdivisions that may be sequenced in any order to match the users preference. Each descriptor field is separately identified by a unique initial code letter which acts as a field separator in long coding strings:

  A for application,
  C for chemical character and product form
  P for processing and
  D for property data.

Overall the utility of the classification system is multi-fold. Its use is advantageous at the company level for purposes involving assembly of design and materials property databases, or tabulation of inventories, or invoicing. Industry can use the system for gathering and sorting trend data on market behavior or R&D expenditures, or for literature categorization. At the government level, the system can be used for gathering national and international economic data, or other vital statistics, or for determining demographics of the field.

• Recent VAMAS Outputs •

EXTENDED ABSTRACT

VAMAS Technical Report No. 16
"VAMAS Round Robin on Fracture Toughness of
Silicon Nitride at High Temperatures"
by M. Mizuno and H. Okuda
Japan Fine Ceramics Center
Nagoya, Japan

Eight laboratories in Germany, Japan, UK, and the USA participated in the VAMAS round robin on high temperature fracture toughness of silicon nitride. This report describes the results of the round robin. The fracture toughness at room temperature and at 1200 °C were measured by three methods: the single edge V-notched beam (SEVNB); single edge precracked beam (SEPB); and chevron V-notched beam (CVNB). The material used was SSN-H silicon nitride made by Kyocera with ytterbia and alumina sintering aids. The values of fracture toughness, $K_{c,n}$ (obtained by the SEVNB method) and K_{1c} (by the SEPB and CVNB methods), were measured as a function of crosshead speed, ambient temperature or atmosphere. The analyzed results are as follows:

1. The SSN-H does not show crosshead speed dependence (rate of loading) on fracture toughness, suggesting that environmentally-assisted crack growth is inactive for the material.

2. Oxidation of SSN-H by heating at 1200 °C in air increases the apparent fracture toughness values by the SEVNB and SEPB methods because of crack healing and/or blunting.

3. The SEVNB values in N_2 are almost the same, irrespective of ambient temperature or crosshead speed, while those at 1200 °C in air are a little higher than those at room temperature. This is probably due to healing of machining damage.

4. The SEPB values at 1200 °C in N_2 are slightly lower than those at room temperature, while those at 1200 °C in air are much higher than those both at 1200 °C in N_2 and at room temperature. This is probably due to the healing, resulting in partial adhesion on precrack surfaces and precrack tip blunting.

5. It requires accurate jigs and some experience to precrack the SEPB specimens properly. One lab observed slow crack growth during the 1200 °C SEPB test. The crack length for calculating K_{1c} should include the length caused by the stable crack propagation.

6. The CVNB values vary according to laboratory due to the difference in machining conditions for introducing chevron notches. However, the CVNB values hardly vary, irrespective of crosshead speed, ambient temperature or atmosphere. This is probably due to the combination of V-notch machining and configuration of a ligament. The scatter was drastically reduced by the use of a V-notch.

7. For high temperature fracture toughness in N_2, the SEVNB and SEPB values are almost the same, and are much lower than the CVNB values. The CVNB method can be used in inert and air atmospheres, but the SEPB and SEVNB methods are not suitable in air.

Although SSN-H does not show a crosshead speed dependence, other materials might do so and this could lead to errors due to subcritical crack growth. At a speed of 0.5 mm/min, the test is over in a few seconds which should give more reliable results if subcritical crack growth corrections are not made because evidence is difficult to obtain. A crosshead speed of 0.005 mm/min is not considered to be practical because the measurement takes much longer. The speed of 0.5 mm/min is recommended.

Ambient atmosphere appears to be a very important factor for fracture toughness measurement of non-oxides at high temperature. Silicon nitride ceramics are subject to oxidation to varying degrees with the heating conditions in air and this affects the fracture toughness. The high temperature fracture toughness in non-oxidizing atmospheres can be measured by the SEVNB and SEPB methods with little scatter in results although the absolute values differ. The CVNB method shows little scatter and is recommended for any measurement conditions. The CVNB values are independent of ambient temperature and atmosphere but the method requires precision machining and a skilled technique to introduce V-notches into specimens.

• Recent VAMAS Outputs •

EXTENDED ABSTRACT

"Fracture Toughness of Advanced Ceramics
at Room Temperature"
by G. Quinn, NIST, Gaithersburg, Maryland, USA
J. Salem, NASA, Cleveland, Ohio, USA
I. Bar-on and K. Cho, Worcester Poly. Inst., Worcester, Massachusetts, USA
and H. Fang, Allied-Signal, Phoenix, Arizona, USA
Journ. of Research of the NIST, Vol. 97, No. 5, 1992

This report presents the results obtained by five USA participating laboratories in the VAMAS round robin for fracture toughness of advanced ceramics. Three test methods were used: indentation fracture; indentation strength; and single-edge pre-cracked beam. Two materials were tested: a gas-pressure sintered silicon nitride and a zirconia-toughened alumina (ZAC). The indentation fracture (IF) method is not commonly used and several laboratories complained that interpretation of the method is "ambiguous." All agreed that it is difficult to measure the cracks accurately and precisely, and that there is significant variability between observers. Four of the five labs felt the method was not reliable. The method is not suitable for elevated-temperature testing. The high scatter in the results of the present round robin indicate that, at the least, better procedures for measuring the cracks are necessary. The participants for the most part felt that the method may be adequate in the laboratory as a research tool, but it is not suitable as a standard for general engineering purposes. These findings are consistent with those of Binner and Stevens in their review paper on this method.

The same distrust about the indentation cracks seems to be held by three of the five labs towards the indentation strength (IS) method. This method is widely cited in the ceramics literature, and is felt to provide a good estimate of fracture toughness despite a concern with its empirical roots and "calibration" constants. The method is not applicable to high-temperature testing. The experimental ease of the method (indent and break, without the need to measure cracks) and the fairly consistent results obtained in this round robin may encourage the broader use of this method as a simple, fast means of estimating fracture toughness for quality control or comparison purposes.

There was generally favorable reaction to the single-edge pre-cracked beam (SEPB) method. Three of the labs routinely use it despite its recent development. One other lab reported that it will be adopted for routine work. Most participants felt that fracture toughness values obtained were technically rigorous for a flat R-curve material in the absence of environmental effects. The extra work entailed in pre-cracking was felt to be worthwhile in terms of the quality of the result. Several labs reported problems with SEPB elevated-temperature testing since pre-cracks are prone to heal.

In overall summary, the round robin was felt to be a success. Reasonably consistent results were obtained for the IS and SEPB methods between most laboratories for two different materials. Several areas were identified where refinements could be made and there is now greater confidence by the USA participants in these two methods. Participants either successfully tried the IS or SEPB methods for the first time, or refined their usual procedures. The IF method was less successful in the round robin.

A single value of fracture toughness for the silicon nitride seems to be appropriate. No R-curve or environmentally-assisted crack growth phenomena were detected. Several questions of interpretation of fracture toughness were raised for the case of the ZAC, which exhibited R-curve and environmentally-assisted crack growth. There is no simple interpretation of fracture toughness for this material. A direct result of this round robin is that the IS and SEPB methods are now under consideration in ASTM Committees C28, Advanced Ceramics, and E8, Fatigue and Fracture, as candidates for standard test methods for advanced ceramics.

• Recent VAMAS Outputs •

EXTENDED ABSTRACT

"Round Robin Test for Standardization of Biocompatibility
Test Procedure by Cell Culture Method"

by T. Tateishi and T. Ushida, AIST, Ibaraki, Japan
H. Aoki, Tokyo Medical & Dental University, Tokyo, Japan
Y. Ikada, Kyoto University, Kyoto, Japan
M. Nakamura, Osaka Dental University, Osaka, Japan
D. Williams, University of Liverpool, Liverpool, UK
B. Clark, University of Florida, Gainesville, Florida, USA
G. Stookey, Indiana University, Bloomington, Indiana, USA
P. Christel, University of Paris, Paris, France
and A. Pizzoferrato, University of Bologna, Bologna, Italy
Advances in Biomaterials, Vol. 10, 1992

An international round robin test was carried out for pre-standardization of biocompatibility test procedures by the cell culture method by TWA 7, Bioengineering Materials. In order to evaluate the biocompatibility of materials, the TWA developed tentative procedures for using cell growth rate and cell adhesion rate tests by the cell culture method based on the results of pre-round robin tests in 1989. The results of the relative cell growth rate studies showed no significant difference at 95% probability among four tested materials, a control material and hydroxyapatite, zirconia, and Ti-6Al-4V, except hydroxyapatite vs. the other materials at one laboratory. The results also show that hydroxyapatite and Ti-6Al-4V have no cytotoxicity and show exponential growth during the first four days of incubation. The cell adhesion results, however, indicated significant differences at 95% probability level between the control and other materials in all of the participating laboratories. Possible reasons include differences in pipetting techniques used by individual researchers and difference cell counting methods used by different laboratories. The test results showed that the procedures yielded reproducible results for cell growth, but that it was necessary to develop a procedure independent of individual personal deviations in cell manipulations in the cell adhesion test.

• Recent VAMAS Outputs •

EXTENDED ABSTRACT

"Evaluation of Low Cycle Fatigue Test Data in the
BCR/VAMAS Intercomparison Programme"
by G. Thomas and R. Varma
NPL,Teddington, UK
CEC Report EUR 14105 EN, 1993

In May 1985 a European programme on intercomparison of low cycle fatigue (LCF) testing was started under the auspices of the EEC Community Bureau of Reference (BCR). Subsequently, as a result of VAMAS, a wider international participation was sought and the final participation consisted of sixteen European and ten Japanese laboratories.

The objectives were to establish a set of high temperature LCF data representative of accepted testing practice and to identify the significant aspects of testing procedure affecting the repeatability and reproducibility as a basis for defining a standard test procedure. The test conditions, including strain ranges, strain rate, waveshape, temperature and limits to testpiece surface finish, were specified in guidelines. However, each laboratory used its normal test methods, i.e. testpiece form, extensometry, testpiece manufacture, test machine and recording equipment. Three classes of alloys were selected for testing according to their cyclic strain behavior. These were defined as strain-hardening (AISI 316L stainless steel at 550 °C), strain-softening (either 9Cr1Mo steel or IN718 alloy at 550 °C) or stable (Nimonic 101 at 850 °C). Twenty-one data sets were supplied for AISI 316L, sixteen for 9CrMo, 12 for IN718 and 12 for Nimonic 101.

The data have been compared using relations between both cycles to failure and stress range at half-life and strain range for each material. Since good reproducibility would be an important requirement of a standard test procedure the results have been assessed on the basis of the relative position of the data sets from individual laboratories within the overall scatter band of all data. The least spread in LCF lives was obtained on the 9Cr1Mo steel; the lives for AISI 316L showed a slightly greater spread; and the greatest spread was obtained on IN718 and Nimonic 101 alloys.

The observations indicated that interlaboratory differences in life were particularly significant in the case of the high strength superalloys tested at low strain ranges. Cyclic hardening or softening behavior was not associated with a consistent trend in the spread of LCF lives. The type of testpiece and extensometry were significant factors in some cases. In particular, methods involving testpieces with transition radii with ridges or that used diametral extensometry gave results that tended to lie at the extremes of the scatterband more frequently than those obtained using smooth parallel testpieces with side-contact axial extensometry. Testpieces with finer surface finishes (lower Ra values) did not generally exhibit greater lives nor did the spread of results bear any consistent relation to surface finish.

Repeatability and reproducibility also appeared to be influenced by material characteristics, in particular the strength of the alloy and the proportion of plastic strain exhibited at the test conditions. The general level of spread in the results could not be attributed to any single major testing parameter, nor was there any evidence of material variability. There was no correlation between LCF results and position of the testpiece with respect to the original source material for any of the materials tested. The spread of results must therefore be regarded as generally typical using current testing practice. The differences in life attributes to different definitions of failure were minor compared with the general interlaboratory variation.

When the full body of data is reviewed in the context of the level of reproducibility normally anticipated in testing of this type it could be concluded that variability within a factor of two about the mean would represent reasonable testing practice. On this basis the results for AISI 316L stainless steel and for the 9Cr1Mo steel would demonstrate an acceptable level of agreement while the two superalloys would not. There is no clear evidence of what steps should be taken to reduce the variability if a factor of two is considered excessive.

Technical Working Area 2

SURFACE CHEMICAL ANALYSIS

Dr. M. P. Seah
Division of Materials Metrology
National Physical Laboratory
Teddington, Middlesex, UK, TW11 0LW
Tel: +44 81 943 6634
Fax: +44 81 943 2989

Objectives

- To provide the measurement infrastructure required for setting standard methods of specifying surface chemical analysis
- To develop an agreed base for principles, definitions and equations for relevant aspects of surface analysis techniques
- To identify reference procedures for materials, data, instrumentation and measurement methods

There has been a high level of activity on both the basic research side and also for the consideration of documentary standards aspects. Details of the ISO Technical Committee 201 on Surface Chemical Analysis are given in VAMAS Bulletin No. 16. The seven ISO TC subcommittees are now approved and new work items are being considered as originally suggested. The following states have P (voting and participating) status on the main or a subcommittee: Austria, China, France, Germany, Italy, Japan, Korea, Poland, Russian Federation, Sweden, Switzerland, Turkey, United Kingdom, and the USA. At the last meeting of ISO TC 201, three new work items resulting directly from VAMAS activities were considered. From the now completed Project 10 (see list of current projects), the full data transfer format has been submitted via the UK for consideration as materials for an ISO standard. From Project 24, the infrastructure for spectral databases had been submitted via the USA for development as an ISO standard and evolving from Project 30, work for Information formats to complement the Project 10 format has been submitted via Japan. These three items will be worked on in ISO TC Subcommittee 3 on Data Management and Treatment. Completion of these projects will enhance the development of both the basic and applied aspects of surface analysis since data will then become transferable and software accessible in a way not possible now.

The outputs from Projects 1, 18, and 19 will be involved directly in the ISO Subcommittee on depth profiling and SIMS. The problem of depth resolution in dynamic SIMS has now reached a stage where the physics of the process rather than defects of the instrumentation are now of major importance, and for this the focus may need to shift more towards the analysis of delta doped layers. Other projects will be involved as indicated in the Matrix of Project Activity. The Matrix clearly shows some need for focus in the SIMS area. Because of the importance of SIMS to the microelectronics industry, efforts will be made to target specific projects for development. A second arena of focus will derive from the ISO TC 201 discussions where some clear areas of technical development have been identified.

VAMAS SCA PROJECT LIST (1 DECEMBER 1993)

Project No:

1.[a] Development of thin oxide films as reference materials (M. P. Seah).
2.[a] Development of calibration data for the energy scales of Auger-electron spectrometers (M. P. Seah, C. J. Powell).
3. Procedures for quantitative X-ray photoelectron spectroscopy (C. J. Powell, J. E. Fulghum for Phase 1).
4.[b] Measurement of spatial resolution in AES.
5.[a] Development of reference materials prepared by ion implantation (W. H. Gries, D. Gould).
6. XPS intensity calibration and stabilization with polymeric reference materials (C. E. Bryson).
7.[b] Correction methods for backscattering in AES (J. P. Langeron).
8.[a] Reference data for sputtering rates in oxides (H. J. Grabke).
9.[a] Intercomparison of Auger-electron energy and intensity measurements (M. P. Seah).
10. Development of a standard data transfer format (W. A. Dench).
11.[a] Multitechnique characterization of vacancies in alumina (C. Le Gressus).
12. Calibration of surface layers by nuclear reaction analysis (I. V. Mitchell).
13. Tests of algorithms for data processing AES - Factor analysis and intensity (P. R. Underhill).
14.[a] (a) Tests of algorithms for background subtraction in XPS (S. Tougaard).
(b) Tests of algorithms for background subtraction in AES (S. Tougaard).
(c) Tests of algorithms for quantitative XPS by peak and peak background shape analysis (S. Tougaard).
15. Evaluation of SNMS sensitivity factors (M. Anderle).
16.[a] Intercomparison of surface analysis of thin aluminum oxide films (P. Marcus).
17. Quantitative AES of Au/Cu alloys (R. Shimizu).
18. Evaluation of LOGIT, an algorithm for fitting sputter-depth-profile data, for the measurement of interface widths of an NBS thin-film reference material (J. Fine).
19. Round Robin SIMS study of impurities in Ga/As crystals (S. Kurosawa).
20. Round Robin AES study of Co-Ni alloys (K. Yoshihara).

21. Tests of algorithms for the analysis of multicomponent spectra in XPS (A. F. Carley).
22. Calibration of channel electron multiplier detection efficiency stabilities (M. P. Seah).
23.[a] Absolute calibration of XPS instrument intensity scales (M. P. Seah).
24. Conventions for spectral data bases (R. N. Lee).
25. Quantitative XPS of Au-Cu alloys (K. Yoshihara).
26. Theoretical assessment of escape depth (R. Shimizu).
27.[a] Multiline reference material for differential AES intensity calibration (M. P. Seah).
28. Quantitative XPS of Co-Ni alloys (K. Yoshihara).
29. Development of a file format translation system (K. Yoshihara).
30. Development of a common data processing system for AES and XPS (K. Yoshihara).
31.[a] Intercomparison of the effects of Al on the determination of thin oxide film thicknesses (P. Marcus).

[a] these projects receive support from the Community Bureau of Reference, BCR, Brussels)

[b] these projects are inactive due to lack of resources

Matrix of Project Activity

	AES	XPS	SIMS	SNMS	SDP
Reference Procedures[a]	9,11,17 20,22,27	3,11,14 16,23,25			
Reference Data[b]	2,7,12	12,26		15	8
Reference Materials[c]	4	6	5,19		1
Software Validation[d]	13	21			
Standard Software[e]	10,24,29	10,24,29	10,24 29		10,182 9,30

AES = Auger Electron Spectroscopy
XPS = X-Ray Photoelectron Spectroscopy
SIMS = Secondary Ion Mass Spectrometry
SNMS = Sputtered Neutral Mass Spectrometry
SDP = Sputter Depth Profiling

[a] Reference Procedures will form bases for documentary standards.
[b] Reference Data will be incorporated in parts of documentary standards.
[c] Reference Materials are often referred to in documentary standards for calibration.
[d] Software Validation is essential for conformance test of a documentary standard.
[e] Standard Software may form a basis for documentary standards.

Technical Working Area 3

CERAMICS

G. D. Quinn
Ceramics Division
National Institute of Standards and Technology
Gaithersburg, MD 20899, USA
Tel: +1 301 975 5657
Fax: +1 301 990 8729

Objectives

- To undertake pre-standardization research on the reliability and reproducibility of test procedures for advanced technical ceramics

Three programs were underway in TWA 3 in late 1993 and early 1994.

The high-temperature fracture toughness round robin, coordinated by the Japan Fine Ceramic Center was a three-year program and was completed in 1993. Single-edged precracked beam, single-edged V notched beam, and chevron notch specimens were used to measure the fracture toughness of a silicon nitride at room temperature and at 1200 °C. Eight of the original twelve laboratories finished their testing in this project. VAMAS Technical Report No 16 "VAMAS Round Robin on Fracture Toughness of Silicon Nitride at High Temperature" by M. Mizuno and H. Okuda was published in December 1993. A report summary is provided elsewhere in this Bulletin (page 15). Results of the high-temperature fracture toughness round robin are being used to help prepare the new Japanese Industrial Standard, JIS R 16XX.

A new fracture toughness project commenced in November 1992 and was completed in September 1993. This project, which featured the surface crack in flexure method, was applied to two silicon nitrides and one zirconia. The National Institute of Standards and Technology in the USA, and the Swiss Federal Laboratories for Materials Testing and Research, Switzerland, coordinated this project. Twenty of the original twenty-four laboratories completed their work on this project. VAMAS Technical Report No 17 is in preparation for this project and should be ready by March 1994. A preliminary report was presented to the American Ceramic Society conference at Cocoa Beach, Florida, on 13 January 1994.

A new project on fractographic analysis of ceramic specimens commenced in May 1993. Thirty-six photos of machining damage and six specimens with various strength limiting defects were sent to each of eighteen participating laboratories in the United States and Europe. This round robin is coordinated by Mr. J. Swab of the U.S. Army Research Laboratory in Watertown, MA, USA in collaboration with Mr. G. Quinn of NIST. The deadline for responses was September 1993 and the results are now being analyzed. A preliminary report on the findings of Topic I, machining damage characterization, was presented by Mr. Swab to the American Ceramic Society Conference at Cocoa Beach, Florida on 13 January 1994.

TWA 3 had a European regional meeting at the Fraunhofer Institute for Mechanics of Materials, Freiburg, Germany on 13 May 1993. Twenty TWA 3 members and visitors attended. Progress was reviewed for the high-temperature fracture toughness, the surface crack in flexure, the fractography, and the quantitative microscopy round robins.

A North American regional meeting was held on 11 January 1994 in connection with the American Ceramic Society meeting at Cocoa Beach, Florida. Ten members and visitors attended. Dr. Mizuno presented the final report on the high-temperature fracture toughness round robin. Progress on the surface crack in flexure and the fractography round robins was presented.

A proposal for a round robin for room-temperature fracture toughness characterization of a silicon carbide whisker-reinforced, silicon nitride composite ceramic will be made by the Japan Fine Ceramics Center.

TWA 3 plans to have a large meeting in connection with the CIMTEC Conference in June 1994 at Florence, Italy. At least four papers will be presented at this conference which deal with the round robin projects performed by this TWA.

The results of the earlier CEN/VAMAS round robin on quantitative microscopy were used to prepare the CEN TC 184 Euronorm ENV 623-3, "Methods of Testing Monolithic Advanced Technical Ceramics, Part 3 - Determination of Grain Size."

The results of all three VAMAS TWA 3 fracture toughness round robins are being used to help prepare an ASTM standard.

POLYMER BLENDS

I. K. Partridge
School of Industrial and Manufacturing Science
Cranfield University
Cranfield, Bedford, UK, MK43 0AL
Tel: +44 234 750111, ext. 2513
Fax: +44 234 750875

Objectives

- To provide the technical basis for drafting standards test procedures for new, high performance polymer alloys and blends in five complementary technical areas: melt flows; dynamic testing; thermal properties; morphology; and mechanical properties

This TWA is in the process of re-focusing its objectives and formulating a three-year plan of work. Following a meeting of the national representatives in April 1993, a project initiation form has now been prepared by the TWA Chairman, for consideration at the Steering Committee meeting in March 1994.

The new program is being developed in recognition of the existence of wide generic problems relevant to the industrially important class of Multiphase Polymers, encompassing within its scope short fiber reinforced polymers as well as immiscible polymer blends. The programme will rely on enhancing synergy between major programmes of work already existing or planned within the VAMAS countries. Three main supporting programmes are already underway: (1) Development of an international standard for moulding a test specimen in form of a plate, led from the UK; (2) Quantification of Morphology, led from Japan; and (3) Development of standards for Fracture Mechanical Tests for polymers by collaboration between VAMAS TWA 4 and European Structural Integrity Society (ESIS) Task Group 4. Other existing programmes will be identified, or initiated, and coordinated so as to provide a significant coherent input into Design Data programmes in the VAMAS countries as well as directly into ISO.

Pending approval of the programme by the Steering Committee, provisional agreement to participate has already been obtained from the following organizations:

UK	British Plastics Federation, BP Chemicals Ltd., Brunel University, Cranfield University, ICI plc, NPL, Raychem Ltd., TWI, University of London, University of Manchester
Japan	University of Tokyo, NIMCR Tsukuba, Bridgestone Corp.
USA	Allied Signal
Germany	BAM (Berlin)
Italy	University of Pisa
France	INSA Lyon
EC	Solvay (Belgium), DSM (Netherlands), ITMA (Spain), ESIS TG 4 on Polymers and Composites

Potential additional participants should contact either their national TWA 4 representative or the Chairman of TWA 4 directly.

METAL MATRIX COMPOSITES

W. S. Johnson
NASA Langley Research Center
Hampton, VA 23681, USA
Tel: +1 804 864 3463
Fax: +1 804 864 7729

Objectives

- To undertake pre-standardization research on the reliability and reproducibility of test procedures and analytical material models for metal matrix composites

The initial project addresses tensile testing of discontinuous reinforced aluminum (DRA) composites at room temperature and elevated temperature.

Silicon-nitride whisker reinforced 2009 aluminum composites were received from Advanced Composite Materials Inc. under the U.S. Air Force Title III program. The material was sent to the National Research Institute for Metals (Japan) for machining. Following machining, the specimens were sent to the participating laboratories for testing. The round robin tests include tensile tests to failure at room temperature and elevated temperature. The moduli, ultimate stress, and failure strains will be measured, reported, and compared for laboratory-to-laboratory variations.

The TWA is still soliciting funds to purchase titanium matrix composites for a second round robin testing program.

• VAMAS Calendar •

TWA 7 Meeting in conjunction with the Bionic Design Workshop '94, Tsukuba Science City, Japan	February 22-23, 1994
TWA 15 Meeting in conjunction with the ASTM Symposium on Life Prediction Methodology for Titanium Matrix Composites, Hilton Head, SC, USA	March 22, 1994
TWA 7 Meeting in conjunction with the 2nd Annual Conference of the Italian Association of in-vitro Toxicology	May 24-26, 1994
TWA 3 Meeting in conjunction with the 8th CIMTEC, Florence, Italy	June 1994
8th CIMTEC Meeting, "Forum on New Materials" & "World Ceramics Congress" Florence Congress Center, Florence, Italy	June 29-July 4, 1994
International Conference on Quantitative Surface Analysis, QSA-8 University of Surrey, Guildford, Surrey, UK	August 23-26, 1994
TWA 15 Meeting (tentative) in conjunction with the 2nd European Conference on Composites, Hamburg, Germany	September 13-15, 1994
TWA 4 Meeting in conjunction with the IoM Conference "Polymat '94", London, UK	September 23, 1994
6th European Conference on Applications of Surface and Interface Analysis Montreux Congress Centre, Montreux, Switzerland	October 9-13, 1994
41st AVS (Surface Chemical Analysis) Denver, Colorado, USA	October 24-28, 1994

EIGHTH CIMTEC INTERNATIONAL CONFERENCE

Authorized by the VAMAS Steering Committee, VAMAS is one of the organizations officially endorsing the 8th CIMTEC and its two major themes, the *Forum on New Materials* and the *World Ceramics Congress*. The VAMAS Chairman serves on the Presidential Committee of the 8th CIMTEC. This international conference will be held June 29 to July 4, 1994 at the Florence Congress Center, Florence, Italy.

The Forum on New Materials program will consist of: a General Session "New Horizons in Materials Research" dedicated to fundamental aspects of process science and advanced characterization of materials; eight Topical Symposia on applications-driven R&D areas (jointly sponsored with the World Ceramics Congress); and a Special Session "Standards and Markets for Advanced Materials". The eight Topical Symposia include: inorganic films and coatings; diamond and diamond-like films; structural fiber composites; superconducting materials; high performance materials in engine technology; intelligent materials & systems; advanced materials for optics, electro-optics and communication technologies; and materials in clinical applications.

The World Ceramics Congress program focuses on Classical Ceramics (10 sessions) and Advanced Technical Ceramics (14 sessions). Two international Symposia will be held on Ceramics in Architecture and The Ceramics Heritage.

For more information, write to 8th CIMTEC, P.O. Box 174, 48018, Faenza, Italy.
Telephone: +546-22461 or +546-664143
Fax: +546-664138 or +546-663362

• Participants & Publications Update •

Each VAMAS participant should have received a copy of the revised Participants and Publications document dated May 1992. This document contains two sections: membership listings for the VAMAS Secretariat, VAMAS Steering Committee, Steering Committee Contacts, Technical Working Areas (TWAs), ISO Contacts, and interested parties who receive the Bulletin but who are not active participants; and the associated VAMAS publications from the TWAs.

It is anticipated that this publication will be re-issued in late 1994. In order to produce this comprehensive summary as expeditiously as possible with the most up-to-date information, the TWA Chairs are strongly encouraged to review the entries for their respective TWAs and the publications list and report all changes to the VAMAS Secretary. All corrections, additions, and deletions to the membership lists should be reported in the following format:

NAME:
TITLE:
ORGANIZATION NAME:
STREET ADDRESS
CITY, STATE OR PROVENCE
COUNTRY, POSTAL CODE
TELEPHONE NUMBER:[INCL. CITY AND COUNTRY CODES]
FAX NUMBER:
TELEX NUMBER:

All corrections and additions to the publications list should contain the following:

AUTHORS:
TITLE:
REPORT OR JOURNAL TITLE:
REPORT NUMBER OR VOLUME NUMBER:
BEGINNING JOURNAL PAGE NUMBER:
PUBLICATION YEAR

Mail or fax all information to: Dr. J. G. Early, VAMAS Secretary, Room B309, Building 223, NIST, Gaithersburg, Maryland, 20899. Fax +1 301 926 8349.
In addition, a flysheet is included with this issue of the Bulletin for individual participants and contacts to update their entry in the VAMAS database held at NPL in the UK.
Mail or fax this sheet with any changes to:
John Sillwood, Division of Materials Metrology, National Physical Laboratory, Teddington, Middlesex, United Kingdom, TW11 OLW.

• VAMAS Technical Working Areas •

Technical Working Area 1
Wear Test Methods
Dr. E. Santner
BAM
Unter den Eichen
D-1000 Berlin 45
Germany
Telephone:+49 30 8104 0020
Fax: +49 30 811 2029

Technical Working Area 2
Surface Chemical Analysis
Dr. M. P. Seah
Division of Materials Metrology
National Physical Laboratory
Teddington
Middlesex
United Kingdom TW11 0LW
Telephone: +44 81 943 6634
Fax: +44 81 943 2155

Technical Working Area 3
Ceramics
Dr. George D. Quinn
Ceramics Division
Room A329/Bldg. 223
National Institute of Standards
and Technology
Gaithersburg, MD 20899
Telephone: +1 301 975 5765
Fax: +1 301 990 8729

Technical Working Area 4
Polymer Blends
Dr. Ivana K. Partridge
School of Industrial Science
Cranfield Institute of Technology
Cranfield
United Kingdom MK43 0AL
Telephone: +44 23 475 0111
Fax: +44 23 475 0875

Technical Working Area 5
Polymer Composites
Dr. G. D. Sims
Division of Materials Metrology
National Physical Laboratory
Teddington, Middlesex
United Kingdom TW11 0LW
Telephone: +44 81 943 6564
Fax: +44 81 943 2989

Technical Working Area 7
Bioengineering Materials
Dr. T. Tateishi
Mechanical Eng. Laboratory
1-2 Namiki, Tsukuba-si
Ibaraki 305,
Japan
Telephone: +81 298 58 7013
Fax: +81 298 58 7291

Technical Working Area 8
Hot Salt Corrosion Resistance
Dr. S. R. J. Saunders
Division of Materials Metrology
National Physical Laboratory
Teddington, Middlesex
United Kingdom TW11 0LW
Telephone: +44 81 943 6522
Fax: +44 81 943 2989

Technical Working Area 10
Material Databanks
Dr. Y. Monma
NRIM
2-3-12, Nakameguro
Meguro-Ku
Tokyo 153
Japan
Telephone: +31 22 46 5208
Fax: +31 22 46 1917

Technical Working Area 12
Efficient Test Procedures for Polymers
Mr. R. P. Brown
RAPRA Technology Ltd.
Shawbury, Shrewsbury
Shropshire
United Kingdom SY4 4NR
Telephone: +44 0939 250383
Fax: +44 0939 251118

Technical Working Area 13
Low Cycle Fatigue
Dr. David Gould
CEC
Directorate General XII
rue de la Loi 200
B-1049, Bruxelles
Belgium
Telephone: +32 2 295 9313
Fax: +32 2 295 8072

Technical Working Area 14
Classification of Advanced Ceramics
Mr. Samuel Schneider
National Institute of Standards
and Technology
Room B309/Bldg. 223
Gaithersburg, MD 20899
Telephone: +1 301 975 5657
Fax: +1 301 926 8349

Technical Working Area 15
Metal Matrix Composites
Dr. W. Steven Johnson
NASA/Langley Research Center
Mail Stop 188E
Hampton, VA 23681
Telephone: +1 804 864 3463
Fax: +1 804 864 3800

Technical Working Area 16
Superconducting Materials
Dr. H. Wada
NRIM
Tsukuba Laboratories
1-2-1, Sengen, Tsukuba-shi
Ibaraki 305
Japan
Telephone: +81 298 53 1196
Fax: +81 298 53 1005

Technical Working Area 17
Cryogenic Structural Materials
Dr. T. Ogata
NRIM
Tsukuba Laboratories
1-2-1, Sengen, Tsukuba-shi
Ibaraki 305
Japan
Telephone: +81 298 53 1039
Fax: +81 298 53 1005

• VAMAS Steering Committee •

USA

CHAIRMAN

Dr. Harry L. Rook
Deputy Director
Materials Science and Engineering Laboratory
National Institute of Standards and Technology
Building 223, Room B309
Gaithersburg, MD 20899
Tel: +1 301 975 5658
Fax: +1 301 926 8349

SECRETARY

Dr. James G. Early
Scientific Advisor to the Director, MSEL
National Institute of Standards and Technology
Building 223, Room B309
Gaithersburg, MD 20899
Tel: +1 301 975 6113
Fax: +1 301 926 8349

CANADA

Dr. Jacques Martel
Director
Industrial Materials Research Institute
75, boulevard de Mortagne
Boucherville, Québec J4B 6Y4
Tel: +1 514 641 5050
Fax: +1 514 641 5101

EC

Dr. Ernest D. Hondros, FRS
Director
EC Joint Research Centre
Petten, Postbus 2
ZG-1755 Petten
The Netherlands
Tel: +31 2 246 5401
Fax: +31 2 246 3393

Dr. A. Garcia-Arroyo
Director
Directorate General XII
European Commission
rue de la Loi 200
B-1049 Bruxelles
Belgium
Tel: +32 2 235 11 11
Fax: +32 2 235 8046

FRANCE

Prof. Claude Bathias
Conservatoire Nationale des Arts et Métiers
Department of Materials Engineering
292 rue St-Martin
75141 Paris CEDEX 03
Tel: +33 1 4027 2322
Fax: +33 1 4271 9329

GERMANY

Prof. Dr. Horst Czichos
Präsident
Bundesanstalt für Materialforschung und -prüfung
Unter den Eichen 87
D-1000 Berlin 45
Tel: +49 30 8104 1000
Fax: +49 30 811 8876

Dr. Ing. Günther Sievers
Regierungsdirektor
Bundesministerium für Forschung und Technologie
Heinemannstrasse 2
D-5300 Bonn 2
Tel: +49 228 59 555
Fax: +49 288 59 3105

ITALY

Dr. Anna Gandini
ENEA
Viale Regina Margherita 125
Roma
Tel: +39 6 85 282 489
Fax: +39 6 30 484 203

Prof. Ing. Paolo Giusti
Università di Pisa
Via Diotisalvi 2
56100 Pisa
Tel: +39 50 511 111
Fax: +39 50 511 266

Prof. Sergio lo Russo
Università di Padova
Via Marzolo U8
35131 Padova
Tel: +39 49 844 312
Fax: +39 49 844 245

JAPAN

Mr. Akihiko Iwahashi
Director, OMST
Science and Technology Agency
2-2-1 Kasumigaseki
Tiyoda-ku
Tokyo-100
Tel: +81 3 3508 4097
Fax: +81 3 3595 0980

Mr. Joichi Takagi
Director, Materials Standards
MITI
1-3-1 Kasumigaseki
Chiyoda-ku
Tokyo-100
Tel: +81 3 3501 1511
Fax: +81 3 3580 8598

Dr. Atsushi Oguchi
Deputy Director General
NRIM
3-12, 2-Chome, Nakameguro
Meguro-ku
Tokyo-153
Tel: +81 3 3719 2271
Fax: +81 3 3792 3337

UNITED KINGDOM

Dr. Kamal Hossain
Head
Division of Materials Metrology
National Physical Laboratory
Teddington
Middlesex TW11 0LW
Tel: +44 81 943 6024
Fax: +44 81 943 2989

Mr. Ian Campbell
Secretary, IHC/TC
BSI
2 Park Street
London W1A 2BS
Tel: +44 71 629 9000
Fax: +44 71 629 0506

USA

Ms. Kathleen Riley
Executive Director
Institute for Standards Research
American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
Tel: +1 215 299 5555
Fax: +1 215 299 5470

Prepared by the National Institute of Standards and Technology, USA
Printed in the UK by Woodgate-Loydor Ltd
for the National Physical Laboratory, Teddington, Middlesex, UK
2.5K/5/94