



International Ceramic Federation

2011-2012 Officers

Current President

Gary L. Messing

Pennsylvania State University
Department of Materials Science and
Engineering,
121 Steidle Bldg., University Park,
PA 16802, USA
Ph: (1) 814 865 2262
messing@matse.psu.edu

President-Elect

Ce-Wen Nan

Tsinghua University
Beijing 100084, China
Ph: (10) 62773587
cwnan@tsinghua.edu.cn

Secretary-Treasurer

Jürgen G. Heinrich

Clausthal University of Technology
Institute of Nonmetallic Materials,
Zehntnerstr. 2a
38678 Clausthal-Zellerfeld, Germany
Ph: (49) 5323 72 2354
heinrich@naw.tu-clausthal.de

Immediate Past-President

Akio Makishima

Japan Advanced Institute of Science
and Technology
1-1 Asahidai, Nomi, Ishikawa
923-1292 Japan
Ph: (81) 761 51 1077
makisima@jaist.ac.jp

Chair, Technical Committees

Danilo Suvorov

Jozef Stefan Institute, Jamova 39
1001 Ljubljana, Slovenia
Ph: 386 1 477 3871
danilo.suvorov@ijs.si

Chair, ICC Meetings Steering
Committee

Katherine T. Faber

President, 4th International Congress
on Ceramics
Science and Engineering
Northwestern University
Evanston, IL 60208-3108
Ph: 847.491.2444
k-faber@northwestern.edu

March 9, 2012

Minutes ICF Executive Council meeting

January 23, 2012

Daytona Beach, FL

In attendance

Gary Messing, President

Akio Makishima, Past President

Danilo Suvorov, Chair Technical Committees

Katherine Faber, President ICC4 and Chair of ICC Meetings Steering Committee

Regrets:

Cewen Nan, President Elect

Juergen Heinrich, Secretary/Treasurer

1. Minutes of Oct 17, 2011 ICF Executive Committee meeting were approved. Although it was noted in Stockholm that we need to include the ICF/ICC logo on future instructions for future meetings an example was not included in the approved minutes. It was decided to add the instructions and requirement to co-list ICC and ICF to the ICF by-laws and instructions to ICC host organizations, and to use an ICC/ICF logo like done for ICC4. Gary will propose wording and add to the meetings during ICC4.
2. A. Makishima reported that the Nominating Committee nominates Cewen Nan as President, Danilo Suvorov as President-elect, and Kiyoshi Okada (Tokyo Institute of Technology) as Secretary-Treasurer for the term 2012-2014. Sylvia Johnson has accepted to serve as Chairperson of the Technical Working Committees
3. D. Suvorov updated us about the representation of the ceramics community in Serbia. As President of the European Ceramic Society he will meet with Snezana Boskovic (The Serbian Ceramic Society, and the Ceramic Division of the Serbian Chemical Society – the official representative to ICF) and Vojislav Mitic to see if the Serbian scientists can determine the appropriate representation of the Serbian ceramics community in ECerS. Once this is resolved we will invite the appropriate organization to represent the Serbian ceramics community in ICF. He hopes to have resolution in early February 2012.
4. ICC4 update (K. Faber) (see attached) A tentative schedule for ICF activities was discussed and has been followed up with K. Faber and Mark Mecklenborg as follows. Exact times and places to come later.

Monday, July 16 7:30 AM ICC Steering Committee, followed by ICF Executive

Meeting. This meeting should end by the start of the plenary session. Room should be large enough for 8-10 people.

ICF Secretariat: c/o The American Ceramic Society
600 N. Cleveland Ave., Suite 210 Westerville, Ohio 43082 USA
Ph: (1) 614-794-5876 Fax: (1) 614-794-5852 E-mail: ICFSecretariat@ceramics.org
URL: <http://www.ceramic.or.jp/icf/>



International Ceramic Federation

During the Opening Ceremony on Sunday evening, the order of the event should be as follows:

Welcome Faber

ICF Welcome Messing

ACerS Welcome Wicks

Messing introduces new ICF President, Cewen Nan and hands over ICF President medal

Nan introduces ICC5 President Li; I hand over ICC President medal; Li says a little about Beijing.

Introduction of Plenary speaker Maxine Savitz - Faber

Monday, July 16 5:30 PM ICF Council Meeting Room should be large enough for 30-40 people

5. ICC Steering Committee report (K. Faber) (see attached reports for ICC5)
6. D. Suvorov updated us on the status of the Technical Working Committees. (see report below). It is important that the working committees are involved in ICC meetings. This time we overlooked including the Education Committee (W. Fahrenholtz) in ICC4 but the Nanoparticle Safety Committee (S. Johnson) is involved. With D. Suvorov's nomination as President-elect we needed to identify a new Chair of the Technical Working Committees. Sylvia Johnson was proposed. Gary asked Sylvia to serve for two years and she agreed beginning at ICC4.
7. Gary said he was updating and reorganizing the ICF membership. He will submit the updated file to A. Makishima for posting on the ICF web site by the end of February, 2012.

Reported by G. L. Messing

ICC4 Report
January 22, 2012
Katherine T. Faber

The 4th International Congress on Ceramics (ICC4) will be held on July 15-19, 2012 at the Sheraton Chicago Hotel and Towers, Chicago, IL. Updates regarding speakers, the ACerS Ceramic Leadership Summit, the Interactive Technology Forum and student support are as follows:

Invited and plenary speakers: 46% from outside US (goal was 40%). Of these 23% from Europe, 18% for Asia, 4% from the non-US Americas. There are still some outstanding invitations.

The ACerS Ceramic Leadership Summit (CLS) will be held in conjunction with ICC4. The focus of the CLS will be entrepreneurship. Delbert Day will serve as the plenary speaker, followed by a panel with tech transfer experts, venture capitalists, etc. The afternoon entrepreneurship session will feature successful start-up companies from Japan, China, Slovenia, Spain, and the US.

Interactive Technology Forum – As of January 19, there were 163 abstracts from 31 countries. Abstracts will continue to be accepted until February 15.

Invitations will be extended soon to rapporteurs and theme editors. This will be an opportunity to engage more overseas members.

Through the National Science Foundation and corporate support, we will be able to provide travel grants to 12 students studying in US and 6 students studying abroad, respectively. Application guidelines will be sent to all ICF member societies.

Further details regarding the meeting can be found at <http://ceramics.org/icc4>

ICC5 Report
January 14, 2012
Longtu Li

The 5th International Congress on Ceramics (ICC5) will be held on August 17-21, 2014 at the Beijing International Convention Center, Beijing, China. The meeting is organized by the Chinese Ceramic Society under the auspices of the International Ceramic Federation. The official website of ICC5 is under construction.

The venue will allow for 7 concurrent symposia. 4~5 plenary talk will be invited. Other invited talks and oral presentations will be arranged by the chairs of each symposium. The tentative list of proposed symposia is as followings:

- Symposium 1: Novel Processing Technology
- Symposium 2: Advanced Engineering Ceramics and Composites
- Symposium 3: Electrical, Magnetic and Optical Ceramics
- Symposium 4: Thin-films, membranes and coatings
- Symposium 5: Ceramics for energy conversion and storage
- Symposium 6: Sustainable Ceramics
- Symposium 7: Ceramics for Medicine, Biotechnology and Biomimetics

Conference Organization:

Three major committees are organizing ICC5. The Organizing/Host Committee is planning local events. The Technical Program Committee is shaping the technical program. The International Advisory Committee has been solicited for speaker nominations. The list for invited speakers is in due course.

Additional information:

A proceeding of abstracts will be published by ICC5.

Accommodations are provided by North Star Continental Grand Hotel (4-star), and by Crowne-Plaza Hotel (5-star). Less expensive housing for students may be available at Huiyuan Service Apartment (3-star). Special hotel rates are in negotiation.

Timeline:

The first announcement – June 2012 during ICC4

The second announcement including detailed information–June, 2013

2012 Technical Committees

	Committee	Chair
1	Information/Communications Committee	Prof. K. Uematsu
2	Education Committee	Prof. W. Fahrenholtz
3	Nanoparticle Safety Committee	Dr. Sylvia Johnson
4	Nuclear Ceramics Committee	Prof. William Lee
5	Ceramics and the Environment	Prof. H. Hosono
6	Novel Sintering Techniques for Ceramics	Prof. T. Goto

1. Information/Communications committee.

The chair of this Committee is Prof. K. Uematsu (e-mail ID:uematsu@vos.nagaokaut.ac.jp). In the last period he did not report any activity.

2. The ICF education committee is one which has worked well under the direction of Bill Fahrenholtz on the ICF2. After that meeting, where a successful Workshop was organized, they also prepared a written report (Attachment 1) that was submitted to the Council. The report had several recommendations, but, to Bill's knowledge, none of them have been followed. Later, his Committee was not asked to organize any Workshop or Session within the ICC3 or ICC4 program.

I truly believe that Bill Fahrenholtz would be willing to participate in ICC much more but would need the support of the ICC Conference organizers.

3. Nanoparticle Safety Committee

The Chair of this Committee is Sylvia Johnson (sylvia.m.johnson@nasa.gov).

The main reported activity of the Nanoparticle Safety Committee in 2011 has been to participate in organizing a symposium at the upcoming ICC4. Steve Freiman, formerly of NIST, has taken the lead in inviting speakers etc. This activity follows on from symposia held at ICC2, ICC3, and PACRIM in 2009.

Speakers include

Nanostructured Ceramics

Sudipta Seal, University of Central Florida

Lynnette Madsen, National Science Foundation

Kathleen K. Eggleston, University of Notre Dame

Lang Tran, Institute of Occupational Medicine

Debra Kaiser, Ceramics Division, Material Measurement Laboratory, NIST

Jeffrey Fagan, Polymers Division, NIST

Charles L. Geraci, NIOSH

Angela Hight Walker, Physical Measurements Laboratory, NIST

4. Nuclear ceramics committee

Prof. Bill Lee (Imperial College, London - e-mail ID w.e.lee@imperial.ac.uk), who is a leader of this Committee, kindly asked to be replaced with another person due to the increased commitments at the Imperial College. He also proposed a candidate who would be according to his opinion respectful and ready to take an active role in the work of this Committee. Based on his suggestion I had several contacts with Dr. Luc Vandeperre (l.vandeperre@imperial.ac.uk) from Imperial College and he is willing to continue the work of Prof. Lee. If the ICF Council agrees with this replacement Prof. Lee will be on disposal to support Dr. Vandeperre with his knowledge and experiences from the previous years.

5. Ceramics and the environment committee

The chair is Prof. H. Hosono (e-mail ID: hosono@msl.titech.ac.jp).

The main activities of Ceramics and the environment Committee in 2011 were:

- a. This committee co-sponsored the "Ubiquitous Element Strategy: Surface Functionalities" symposium with Secure Materials Research Center of Tokyo Institute of Technology at The Fifth International Conference on the Science and Technology for Advanced Ceramics (STAC5), June 22-24, 2011, Yokohama, Japan, and
- b. The Committee chair Hideo Hosono described a topical review article on new functionalities in abundant element oxides: ubiquitous element strategy in *Sci. Technol. Adv. Mater.* 12, 034303-1-17 (2011).

Among plans for 2012 it is worth to mention that members of this Committee will take an active role in organization of International Workshop on Ubiquitous Element Strategy for Innovative Materials Science.

6. Novel sintering techniques committee

In 2011 the leadership of the Committee was awarded to Prof. Takashi Goto (goto@imr.tohoku.ac.jp).

He is reporting about the following main activities in 2011:

a. The Committee Endorsed:

The 2nd International Symposium on Advanced Synthesis and Processing Technology for Materials (ASPT2011)

2011.12.1-1 in Sendai, Japan

Total number of attendees 181

A keynote lecture: Prof. Mats Nygren, Stockholm Univ., Sweden "Spark plasma Sintering Activities in Europe during the 2000's: A review"

In this conference, advanced synthesis processing mainly for ceramics was intensively discussed. Prof. Nygren reviewed spark plasma sintering activities as a keynote lecture.

b. The Committee Endorsed:

The 16th Spark Plasma Sintering Conference

2011.11.21-22 in Sendai, Japan

Total number of attendees 60

A keynote lecture: Prof. Rishi Raj, University of Colorado at Boulder
"Flash-sintering: A new form of field assisted consolidation of ceramics"

In this conference, Only SPS was discussed as a material fabrication process.

Co-related

Pac Rim 9: The 9th International Meeting of Pacific Rim Ceramic Societies 2011.7.10-14, Cairns, Australia. Very first lecture (invited) was Prof. Takashi Goto, Tohoku University, Japan "SPS sintering of CBN-based composites combined with rotary chemical vapor deposition".

He reviewed SPS and recent research of SPS as an ICF Novel sintering Committee.

7. Suggestions for other committees

An open matter for discussion!

8. Recommendation of the Chinese members to be included:

This is a list of candidates and titles for new proposals which we received already 2 years ago.

- 1) Prof. Xiangming Chen, Zhejiang University, for the Information Committee.
- 2) Prof. Yali Li, Tianjin University and Prof. Jianghong Gong, Tsinghua University, for the International Conference Committee.
- 3) Prof. Yong Huang, Tsinghua University, for the Education Committee.
- 4) Prof. Changsheng Deng, Tsinghua University, for the Nuclear Waste Committee.
- 5) Prof. Jianbao Li, Tsinghua University, for Ceramic Energy/Environment Committee.
- 6) Prof. Junfeng Ma, China Academy of Building Materials, for Analytical Procedures.
- 7) Prof. Hongjie Luo, Shanghai Ceramic Research Inst., for Art and Archaeoceramics.

New proposals:

The areas that may be in the interest of our Society are as follows:

- Ceramics and Energy (Prof. Lidong Chen, Shanghai Institute of Ceramic Research)
- Ceramics and Resources (Mr. Shuhai Wang, Zhong Cai Heng He Co. Ltd)
- Ceramics and Environment
- Ceramic and Biomaterials (Prof. Yingjun Wang, China South Univ. of Technology)
- Advanced Ceramics (Prof. Wei Pan, Tsinghua University)
- New Fabrication Process (Prof. Zhengyi Fu, Wuhan Univ. of Technology)

Report prepared by:

Danilo Suvorov

23rd January 2012

ATTACHMENT 1

ICF Technical Committee on Education

Report on Activities 2007-2008

Prepared by Bill Fahrenholtz on 15 July 2008

1. Overview

This report summarizes the activities of the Technical Committee on Education of the International Ceramic Federation. The committee was formed during the summer of 2007 with the intent of delivering a report to the ICF council at ICC2 in Verona, Italy. During late 2007 and early 2008, an informal survey was assembled and distributed to faculty. Emphasis was placed on gathering information from India, China, Japan, and the U.S as the European countries were presumed to be well represented at the meeting. For the committee meeting, Dr. Babini solicited several presentations from faculty representing various schools around Europe. These presentations served as the core of the committee meeting and are

summarized below. The final act for the committee in the current meeting cycle is delivery of this report to the ICF Council.

2. Pre-Meeting Activities

In the previous year, an informal survey was prepared and distributed. The survey was designed to determine the size of the faculty and student bodies of materials-related departments along with the current focus and possible future trends. The common themes that appeared in the surveys are summarized in bulleted lists below. The first series of questions in the survey focused on general status of education programs related to ceramic materials.

Undergraduate Status

- Most ceramic engineering education is now accomplished in broader departments of Materials Science and Engineering
- A few stand-alone ceramic engineering programs exist. This number appears to be stable for the near term. At most, one or two programs exist per country.
- In many materials departments, the only mechanism available to focus on ceramic materials are a few upper level courses that may be either required or electives.
- Although difficult to determine precisely, the percentage of students focusing on ceramic engineering at the undergraduate level varies from none to as high as 50% in Materials Science and Engineering programs.
- One common thread from around the world is that a large number (generally around 50%) of the students focusing on ceramics as undergraduates go to graduate school.
- Enrollments vary widely. Some programs have just a handful of undergraduates, while others number in the hundreds. Regardless of size, enrollments are steady to increasing.
- Enrollments at the undergraduate level seem to depend on the availability of jobs and the recruiting efforts of the departments. No organized effort exists to promote interest in undergraduate education in ceramic engineering.

Undergraduate Trends

- The focus of the undergraduate materials programs is broadening away from the traditional areas of ceramics and metallurgy. Polymer science and engineering is also a mature part of many programs. Emerging courses and emphasis areas include nanomaterials, biomaterials, life-cycle design, sustainability, materials for energy applications, and other areas.
- Globalization is having an impact on undergraduate programs. Courses are being added to the curricula, exchange programs are increasing, and more foreign-born undergraduates are entering programs.
- The trend of administrative mergers is continuing so that many materials programs are being merged into larger engineering departments (e.g., Department of Chemical Engineering and Materials Science). This typically does not impact the curricula of the degree programs.

- Europe and America: Fewer total materials programs with larger student numbers
- Asia: More programs and more students.

Graduate Status

- Graduate-only programs focusing on ceramic materials can be viable. Even among departments with undergraduate and graduate programs, the graduate programs can be larger than their undergraduate counterparts.
- The graduate focus is determined by faculty expertise and the availability of research funding, whereas the undergraduate programs are largely determined by administrative directive.
- Graduate education has been stabilized by the availability of basic research funding, most often from government sources.
- In most countries, around 50% of graduate students are foreign born.
- Most students who receive advanced degrees stay in the country where they are educated.
- A common concern worldwide is the availability of future faculty with training that has the appropriate depth in ceramic science to enable continued cutting edge research programs. No general driving force exists for universities to hire faculty with expertise in ceramics.
- Globalization is increasing the number of multi-country research collaborations.

Graduate Trends

- Funding for energy and environmental applications continues to increase and will likely drive the need for continued research in ceramic materials.
- Availability of faculty with appropriate training is a concern.
- Industrially relevant research is increasing.

3. Committee Meeting at ICC2

A meeting of the ICF Technical Committee on Education was organized for ICC2 in Verona, Italy. The meeting was scheduled for a four hour time slot and was advertised in the conference program guide. In the range of 20 to 30 attended the meeting and nearly 15 stayed for the final discussion. The meeting consisted of an introduction by the committee chair (Fahrenholtz) and presentations from five speakers. The presentations were followed by a group discussion to identify common themes from the presentations and to identify possible future trends related to education. Brief summaries of the presentations and discussion are provided below.

Jerzy Lis: Vice Rector, University of Science and Technology, Krakow
Ceramics Higher Education in Poland

- Education must serve multiple markets including industry, research and development, and the ceramic market
- Two types of ceramics education in Poland: 1) the materials science track that concentrates on the basic physics and chemistry of materials; and 2) the chemistry and chemical technologies track that concentrates on industrial needs.
- The typical B.S. program takes 3.5 years to complete and consists of two years of common courses in math, chemistry, and physics after which the students must decide if they are going to focus on route 1 or route 2. Then, an additional 1.5 years of focused training occurs. If the student chooses to continue into the M.S. program, a more focused program is selected, for two years of study. The Ph.D. program includes four years of research in a highly focused area.
- Every student gets industrial experience during his or her undergraduate studies.
- Small to medium sized employers dominate hiring in Poland.

Ferhat Kara: Anadolu University, Turkey
Ceramics Higher Education and Industry-University Collaboration in Turkey

- 14 MSE programs in Turkey, one focused on ceramic engineering
- The European standards for B.S. and advanced degrees have led to challenges in terms of balancing the breadth and depth of materials programs.
- A large need in Turkey and all of Europe for workers who are skilled, flexible, and innovative. Need strong fundamental training combined with the ability for life-long learning.
- The ceramic industry in Turkey is focused on the production of tile and sanitary ware.
- The need for “industrial” or “professional” PhDs has been identified as distinct from the typical fundamental research PhD program.
- A ceramic research center has been established at Anadolu to provide R&D expertise to the industry. Around 30 PhD students are working on 23 different research projects. Each student spends ~25% of his/her time working in industry. The benefits are: 1) well-trained employees for industry; 2) R&D funding and infrastructure for the university; and 3) a funded graduate education for the students.

Jeff Smith: Missouri University of Science and Technology
An International Industry-University Partnership Focused on Materials
Research and Education

- The refractories industry recognized the need to attract “global talent.” Students were needed with relevant skills and a willingness to travel to plant locations around the world. They recognized that most students tended to stay in their birth country or in the country in which they were educated.
- The traditional university education needed to be supplemented with: 1) experiences with cultural diversity, especially involving international situations and/or local customs; 2) learning in a non-local environment; 3) understanding of the global economic system; 4) communication with those speaking other languages; and 5) other skills such as languages, the ability to live in other countries, etc.
- The Federation for International Refractories Research and Education (FIRE) includes universities and companies from around the world focused on training PhD students for the global refractories industry.
- A balance had to be struck between the requirements of the universities and the companies, which had significantly different criteria for oversight.
- Uniform standards had to be established so that students from all of the schools received comparable educations.
- A balance between depth and breadth was needed.

Abhi Ray: University of Technology, Sydney
Ceramics Higher Education in Australia

- Sixteen universities in Australia have programs in materials science and engineering. Specialization in ceramics at the undergraduate level is rare.
- The numbers of students in graduate programs are greater than those in undergraduate programs. Significant growth in graduate programs has occurred in recent years.
- Materials-related courses are found in several departments at most universities including engineering, physical sciences, architecture, and those related to nanotechnology.
- The strengths of the programs are close ties to industry, significant support from industry, and the broad skill range of graduates. Some of the weaknesses are that most engineering curricula have insufficient materials content, materials disciplines are perceived as boring, and it is difficult to attract the specialized academic talent needed to staff the programs.

David Smith: Ecole Nationale Supérieure de Céramique Industrielle, Limoges
Ceramics Higher Education in France

- About 220 engineering programs in France. Four have programs that emphasize ceramic materials to some degree.
- Traditionally, technical degrees require two to three years while science based degrees take five years. Under the old system, the first two years were general followed by three years of specialized study.

- The engineering programs in France are resisting migration to curricula consistent with the Bologna protocol for European universities.
- ENSCI is focused on the utilization of ceramic materials. The school has about 180 undergraduate students divided among the three years with about 30 graduate students and 26 faculty.
- The program includes Two years of study in science, technology, and general studies followed by one year of specialized training. Students are also required to complete a final year research project as well as an industrial traineeship program.

Following the presentations, a discussion session was held to summarize common themes among the presentations and to identify future trends that will impact ceramic engineering education worldwide.

Common Themes

- A strong driving force is needed to maintain discipline-specific degree programs in ceramic engineering. At the undergraduate level that has historically been the traditional ceramics industry. The decline in need for ceramic engineers in this industry coincided with the loss of the degree programs. One or two ceramic engineering programs per country are now sufficient to produce the required number of students with undergraduate degrees in ceramic engineering. No prospect for increasing the number of programs is foreseen.
- Most countries have a strong need for additional capacity to train ceramic technologists. No organized effort is supporting this transition and the need will likely remain unmet in most countries.
- The need for skilled researchers is driven by the current status of the “high tech” ceramics market. Continued strength of graduate programs is foreseen. Currently, most programs offer “fundamental research” PhD degrees, although an increase in industrial support is driving the creation of “professional” or “industrial” graduate degrees.
- Most faculty members have no industrial experience. This has coincided with the transition of the programs to more of a “research” focus.
- At the undergraduate level, demands such as accreditation and government policy make it difficult to balance the depth of study with the breadth of experience in all countries.
- With the decline of the traditional ceramics industry and the loss of focused undergraduate programs, the current and future availability of faculty with appropriate training in ceramic engineering is a general concern.
- Most countries have a very robust job market for materials/ceramic engineers. In some countries, the market is better at the graduate level than the undergraduate level.

Future Trends

- The number of programs with a focus on ceramic materials is expected to continue to decline. However, those that retain ceramic engineering training will likely increase the degree of specialization in their programs.
- An increase in the number of “consortia” focused on ceramic engineering education is expected. This may occur at all levels (technologists, B.S. degrees, advanced degrees). Rather than covering the entire spectrum of ceramic engineering, consortia are expected to be highly focused on specific areas (e.g., the Ceramics Research Centre at Anadolu or FIRE). It is nearly impossible for programs to induce change in university diplomas/degrees, so the development of joint or multi-institutional degree programs is nearly unlikely. It is more likely that groups can be commissioned to grant certificates in these specialized areas.
- High demand for technologists is expected. The question remains as to whether universities can admit and train technologists based on the current models of admissions standards and government-approved diploma/degree programs.

4. Suggestions for Future Activities

Now that the first meeting of the ICF Technical Committee on Education has been held, several suggestions can be given to guide future activities.

Near Term

1. The ICF Technical Committee of Education should be formalized and populated. The committee needs to be given a clear mandate and guidelines for expectations.
2. It is suggested that representatives to the committee should be made by the ICF member societies. The representatives should commit to being active participants in the process. Nominations should come from the participating societies with the ICF executive committee approving the nominations and selecting the committee chair. Participation of a member of the ICF council in committee activity would lend credibility to the effort.
3. The information exchange at ICC2 was valuable for all of the participants. For the current meeting, most of the participants were from Europe, which turned out to be beneficial. The proximity increased the probability of having representation from the appropriate institutions and allowed the activities to be more focused on just a few schools. For the next ICC, it is recommended that this approach be taken and that the committee focus on activities in Asia (Japan, Korea, China, Australia, etc.).

Long Term

1. The diminishing number of undergraduate and graduate programs focused on ceramic engineering education has created a need for coordination on a

larger scale. Because only one or two programs focused on ceramic engineering are left in any country, a larger sampling base is needed to understand what is happening in the remaining programs. The ICF Technical Committee on Education can provide a forum for information exchange among the programs focused on ceramic engineering education. Because a significant fraction of ceramics education occurs in broader materials departments, any education-related effort must include faculty focused on ceramic education and/or research from those groups.

2. The ICF should explore the need to develop certificates for ceramic engineering education at levels including technologist, undergraduate, M.S., and Ph.D. Uniform criteria will have to be established by consulting with the needs of employers and the current degree requirements of institutions. Differentiation between a specialist (e.g., a ceramic engineer) and a generalist with some experience (e.g., materials engineer with ceramic training) may be needed at all levels. Potential employers should be questioned about the value of a certificate program before any action is taken.
3. The ICF should explore the need to establish additional education consortia. Do other industries need programs like FIRE to train future employees or like the Ceramic Research Centre at Anadolu University? The ICF may be able to facilitate partnerships among academic institutions or connect industrial companies with individual or groups of universities. The existing consortia are at the graduate level, but they may be of value at the technologist and undergraduate levels as well.