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Preface

Syntactic and composite foams: Proceedings of an Engineering Conferences International (ECI) conference

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A conference titled **SYNTACTIC AND COMPOSITE FOAMS**, under the auspices of Engineering Conferences International (ECI), was held during the period of August 1–5, 2004 in Banff, Alberta, Canada. The objective of this conference was to provide a forum for discourse among scientists and engineers from varied backgrounds on the subject of syntactic and composite foams.

Through the expanding variety of hollow and solid particles, nanoparticles, the incorporation of fibers, and processing innovations, an interesting class of foams with unique properties has evolved. Work in syntactic foams has expanded over the past three decades, beginning as simple two-phase polymer matrix foams based upon hollow glass or polymer spheres for applications in the marine and submarine industry. The field has expanded to include polymer, metal and ceramic hollow spheres and matrices. In addition, with fibers and interstitial voids engineered into the material, three and four-phase materials are now possible. Other composite foams have grown out of conventional blown polymer foams to now include the addition of particles, fibers and/or functional elements, resulting in complex microstructures that can be engineered to meet specific applications. Also, blown polymer foams are now used as precursor structures for metal and ceramic composite foams. These foams are typically used in applications that take advantage of their very high specific properties, pore structure, energy absorption characteristics, biological compatibility, and flame retardant properties. By incorporating hollow and solid particles, nanoparticles, fibers, and specialized foaming agents, coupled with novel processing techniques, unique and tailored foam properties can be attained. Because of these innovations, the role of syntactic and composite foams has expanded into the aerospace, automotive, communications, biomedical, electronics, sporting, and transportation industries.

Because of the strides made over the last few decades, the time was right to bring together the leading researchers and manufacturers of these materials for interaction, problem solving, and future collaborations. The conference provided a very valuable forum for discussions on the growing field of composite foams with presentations covering research, development and production of syntactic foams and rigid polymer, metal, and ceramic foams containing a reinforcing and/or functional phase.

Microballoons can be made of various materials, although glass microballoons are by far the most common of all. Carbon microballoons are becoming quite important because of their distinct characteristics. At the present time, it would appear that carbon microballoons (CMBs) show a much greater variability in size than glass microballoons (GMBs). We should mention here some of the open-ended questions brought up at the open-discussion session of the meeting. How do the size and size distribution of microballoons affect the mechanical properties of the MBs and the resultant foam? Which leads to another important point: Do we have the ability to produce a given size distribution of MBs? The answer to this question is yes. It should be pointed out that a very narrow distribution of MBs is not desirable from the point of view of the flow properties of MBs and mixing with the resin to produce the syntactic foam. The viscosity becomes very high and flow becomes difficult. We need standards on materials and wall thickness of MBs and characterization techniques for MBs. GMBs are more spherical than CMBs, which results in a better packing of GMBs than CMBs. CMBs are more irregular in shape, agglomerated, and have more defects on the surface. These differences result from the different processing used to produce GMBs and CMBs. GMBs are produced by blowing of silica based glass while CMBs are made by carbonizing phenolic microballoons. The phenolic microballoons are sticky and tend to agglomerate. It would be of interest to know the distribution of defects on the surface of MBs. Characterize the different types of defects, and determine the critical type of defect. Types of defects:

- nested microballoons
- nonuniformity of thickness

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- broken microballoons
- debris consisting of wall fragments of MBs, impurities such as anti-caking agents

It would be desirable to have a quantitative measure of the quality of MB.

On the subject of composite foams, a variety of material systems, processing techniques cell formation, and applications were presented. Many of them dealt with the processing and characterization of biocompatible foams and may serve as scaffolding for growth of hard and soft tissue. In addition to these biocompatible foams, composite foams with metal, glass and polymer constituents were discussed. Not surprisingly, many of the same issues arise when discussing porous matrices as in conventional non-porous counterparts, such as materials optimization for specific applications, processing, and modeling challenges, in addition to the contribution to of the reinforcing phase.

The papers presented at this conference covered the production and characterization of reinforcing and functional materials specifically used for these foams (i.e., hollow spheres, micro/nanoparticles, particles with specific electric, magnetic, dielectric properties, biological, etc.) as well as fabrication, characterization, modeling, and applications of the foams. In the collection of papers included in this special section, the reader will find papers covering a variety of topics on subjects of determination of properties of individual microballoons, a variety of foams and foam-based composites, effect of moisture and aging on foams, ballistic properties of sandwich composites containing aluminum foam, etc.

An international organizing committee with representatives from universities, industries, and government laboratories was involved in reviewing the papers for publication in this special section of Journal of Materials Science.

Conference organization

The conference was chaired by Dr. G. M. Gladysz (Los Alamos National Laboratory, NM, USA), Professor K. K. Chawla (University of Alabama at Birmingham, AL, USA), and Dr. A. R. Boccaccini (Imperial College, London, UK).

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Editors
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