Diamond Based Composites

and Related Materials

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Diamond Based Composites and Related Materials

edited by

Mark A. Prelas

University of Missouri,
Columbia, MO, U.S.A.

Andrew Benedictus

University of Missouri,
Columbia, MO, U.S.A.

Li-Te Steven Lin

The Institute of Physics, Academia Sinica,
Taipei, Taiwan, R.O.C.

Galina Popovici

University of Illinois,
Urbana, IL, U.S.A.

and

Peter Gielisse

Florida State University,
Florida A&M University,
Tallahassee, FL, U.S.A.

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DIAMOND BASED COMPOSITES

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FOREWORD

The objective of this meeting was to discuss the state of the art in the development of advanced composite materials using wide band gap materials (diamond and cubic boron nitride) and potential applications for these materials. The goal of this workshop was to bring together the scientific and industrial communities. It is well known that the level of materials science in the Former Soviet Union was very high. Specifically, there has been a great deal of work done on diamond and other wide band gap based composites. The Diamond (and other wide band gap) Based Composites (DBC) workshop was designed to bring together leaders in the scientific community and industry of the western and former eastern block countries to engage in discussions in this important technical area. Only with this free exchange can both the western and eastern communities fully understand the state of the discipline, to understand what research avenues to pursue, and to advance the development of the DBC technology for applications.

Diamond-based composites offer the advantages of diamond and related materials like hardness, high Young's modulus as well as other properties. These material have demonstrated new and unexpected features like unusual stability against high temperature and pressure shocks, a large internal surface that can be technologically controlled, a possibility to control electric, magnetic and optical properties etc... A feasibility of controlling internal surface variation over wide limits offers potential for DBC applications as efficient filters, absorbent, sensors and other tools of environmental control and monitoring.

The DBC NATO Advance Research Workshop covered topics including problems of synthesis of the materials, their characterization and properties. Significant attention was paid to trends in high pressure and high temperature technology. Additionally, low pressure technologies for synthesis of DBC and related materials was addressed. One of the highlights of the conference is a description of achievements in nanocomposite technology. Basic principles of DBC material science was considered with an accent on future developments in the fields of electronics, optics, industrial tools and components, biotechnology and the medicine.

The workshop focused on the issues of development of wide band-gap materials in composites. The topics ranged from molecular clusters, nanophase materials, growth, processing, and synthesis. Commercial composite materials have been on the market for a number of years specifically as abrasives.

The processing of composite based materials can be categorized by six basic methods: 1) In situ growth - high pressure high temperature "catalytic" conversion; 2) mix and sinter such as c-BN plus metal (ceramic polymer) mix; 3) direct sintering; 4) direct polymorphic conversion; 5) shock detonation; 6) SHS sintering.

One of the highlights of the meeting was the work by Guseva and Babaev in which linear chain N-doped carbon films were created with s-p hybridization. These films underwent shock wave compression to transform the C(sp):N to C(sp³):N. This work detailed the characterization of the material which indicated that carbon nitride was formed.

Mark A. Prelas

University of Missouri
Columbia, MO 65211 USA

Andrew Benedictus

University of Missouri
Columbia, MO 65211 USA

Li-Te Steven Lin

The Institute of Physics, Academia Sinica
Taipei 11529, Taiwan, R.O.C.

Galina Popovici

University of Illinois
Urbana, Illinois 61820 USA

Peter Gielisse

Florida State University
Florida A&M University
Tallahassee, Florida 32310