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Multicomponent Ultrafine Microstructures

Editors: L. E. McCandlish, D. E. Polk, R. W. Siegel and B. H. Kear

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Multicomponent Ultrafine Microstructures

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Preface

In 1986, a small group of researchers, recognizing the growing importance of ultrafine microstructures as a scientific discipline, decided that it was time to provide a forum for those interested in this interdisciplinary field. This led to the first symposium on the subject, Multicomponent Ultrafine Microstructures, sponsored by the Office of Naval Research at the Fall Meeting of the Materials Research Society. The attendance at this one and one-half day meeting was small but sufficient to justify a continuation of the dialogue at future symposia. The 1988 meeting represents the second in this new series. As before, the scope of the meeting was limited to metals, ceramics, polymers and their composites. Semiconductor, superconductor, and opto-electronic materials were excluded because they are being adequately covered by other symposia.

The 1988 meeting was a two-day symposium addressing the preparation, characterization, and properties of materials with ultrafine or "nanophase" structures. These materials are characterized by microstructures in the 1 to 100 nanometer range. Indicative of the rapid growth and intellectual excitement in the field, the attendance at the symposium averaged 150 and at one stage overflowed the conference room.

In these proceedings, the 33 articles are organized under four main headings: ceramics; composites; alloys, metals, and magnetic materials; multilayers and superlattices. At this stage in the development of the field, research emphasis is on the synthesis and characterization of novel nanophase materials. Chemical and physical vapor deposition techniques remain one of the most active research areas in the synthesis of nanophase materials. A growing activity in the chemical synthesis of nanophases is apparent. Such methods depend on controlled thermochemical conversion of precursor molecules to achieve the desired ultrafine microstructures. A major effort is being made to characterize the intergranular and interphase interfaces using x-ray and neutron scattering, Mössbauer spectroscopy and coercivity measurements, atom probe, and high resolution electron microscopy. Controversy still exists regarding the nature of grain boundaries in nanophase materials produced by compaction of fine powders. Some authors claim that these boundaries have a random gas-like structure, whereas others contend that the boundaries are of conventional type, although perhaps containing a distribution of small pores. Major contributions have been made in the determination of magnetic and mechanical properties. Mechanical property data is extensive in a few areas, e.g., materials produced by mechanical reduction of metal based systems or by cold compaction and sintering of

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ultrafine ceramics. Confirmation of the supermodulus effect has been obtained in many different multilayered materials. Understanding of critical phenomena in nanoscale multilayer structures has also advanced.

February 1989	L.E. McCandlish
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