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Preface

Proceedings of the International Workshop on Interfaces: Ceramic and Metal Interfaces: Control at the Atomic Level June 23–27, 2002, Oviedo, Spain

This volume contains most of the papers contributed to the International Workshop on Interfaces: "Ceramic and Metal Interfaces: Control at the Atomic Level" held on June 23–27, 2002 in Oviedo, Spain. About 75 invited scientists from 12 countries participated in the Workshop. New results were reported in 39 oral contributions, 27 poster presentations and many vigorous discussion meetings.

Conferences on "Interfaces" have been held in Spain on four previous occasions—in 1990, 1993, 1996, and 1999. The first conference in 1990 emphasized the importance of characterization. The second conference in 1993 stressed the correlation of processing, properties, and characterization with an emphasis on ceramic/metal interfaces. The proceedings were published in *Scripta Metallurgica et Materialia*, 31(8), 1994. The third conference in 1996 dealt with the role of interfaces. The proceedings were published in *Acta Materialia*. The fourth conference took place in Sevilla, in 1999 and examined the progress on ceramic and biomaterial interfaces. The proceedings were also published in *Acta Materialia*. Each meeting summarized the state of the art, defined the key outstanding problems, and promoted collaborations and exchanges that helped advance the field during the ensuing years. The conference in Oviedo in 2002, "Ceramic and Metal Interfaces—Control at the Atomic Level," summarized the progress in the field over the last 3 years. It also served as a benchmark of accelerating progress in materials interfaces.

Increasingly it is being recognized that new applications for materials require functions and properties that are not achievable with monolithic materials. Combining dissimilar materials for these new applications creates interfaces whose properties and processing need to be understood before they can be applied commercially. Materials interfaces play a critical role in different areas of materials science such as metallic interconnects in semiconductors, adhesion of oxide scales on metal substrates, thermal barrier coating, and composites and bonding between bulk parts of metals and ceramics. It is of great interest to correlate the microstructure of those interfaces to their properties.

The purpose of this International Workshop on Interfaces was threefold: to summarize the progress made in the science of interfaces over the last 3 years; provide a forum for discussing the fundamental properties of materials interfaces in a wide spectrum of applications (including composites, microelectronic packaging, materials joining, functionally graded systems, thin films, and biomaterials); and, through new insights gained from researchers with very diverse backgrounds and points of view, advance our understanding of the common aspects of materials interfaces in these widely differing fields to stimulate new developments and breakthroughs for the forthcoming decade.

The characterization of materials and materials systems is an essential aspect of materials science. A few decades ago it became obvious that, because the properties of materials depend so critically on the microstructure of their components, this characterization must be determined to the atomic level. Over the last 12 years, this conference series has examined various aspects of interfacial microstructures spanning a broad range of length scales. Properties can be limited by atomic-scale features, by inhomogeneities that arise at a scale of multiple grain sizes, and by the occasional but severe defect in the microstructure. The decade has witnessed an increased interest in the development of materials in which properties depend strongly on the direction in the sample or vary with position in a controlled way. The use of nonequilibrium structures carefully designed at the micron or submicron scale provides new routes to processing and joining materials where interfaces play an important role. Exciting new tools for materials characterization have also emerged that provide information on particular aspects of interfaces and microstructure that previously were difficult to quantify. Atomic force microscopy and orientation imaging microscopy are examples of such new research tools.

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The Oviedo conference included summaries of our progress in the experimental and theoretical domains. Specific topics of research where the atomic-scale or near-atomic length scale is of particular relevance include: the nature of thin intergranular films in structural and electronic ceramics, the distinction between physical and chemical grain boundary widths, the role of interphases and atomic-level interactions in composites and ceramic-metal systems, and the growth of textured thin films on both solid substrates and on two-dimensionally assembled organic molecules. An increased level of attention to the atomic scale is evident. There has also been substantial progress in other areas, where the relevant length scale is somewhat larger. Similar challenges have been formulated for the materials sciences community by the life sciences. The interaction of molecular biologists, materials scientists, and bioinformatics will create new methods for materials processing. The biomaterials session provided an insight into this rapidly growing area of the design of materials for specific roles in biological systems.

The organization of this volume follows that of the Workshop with sessions on Computational and Theoretical Aspects of Interfacial Properties, Wetting and Segregation, Interfacial Characterization, Biomaterials Interfaces and Nano and Interface Films.

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