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2008 J. Phys.: Condens. Matter 20 260301

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J. Phys.: Condens. Matter **20** (2008) 260301 (1pp) doi:10.1088/0953-8984/20/26/260301

PREFACE

Oxide Surfaces

Guest Editor

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Although the history of metal oxides and their surfaces goes back several decades to landmark studies, such as Mott and Peierls' explanation of electrical insulation in materials that are predicted in band theory to be conducting, or the observation by Morin of the superfast metal-to-insulator transition in vanadium dioxide, it is only in the last two decades that the world of condensed matter physics has become increasingly dominated by research into complex metal oxides. This has been driven most notably by an attempt to better understand and describe the fundamental physical processes behind their seemingly endless spectrum of properties, which in turn has also led to the discovery of novel phenomena, most prominently demonstrated by the discovery of high-temperature superconductivity in 1986, colossal magnetoresistance in 1994, and most recently, the formation of a two-dimensional conducting layer at the interface between two band insulators in 2004.

One important reason why metal oxides, particularly in the form of thin films, have become such a popular subject for basic condensed matter research is that they offer a uniquely versatile materials base for the development of novel technologies. They owe this versatility both to the many different elemental combinations that lead to structurally similar forms, and also to the fact that in many cases, the strong interaction between the valence electrons means that there is a subtle interplay between structure and magnetic and electronic properties. This aspect has led in recent years to the birth or renaissance of research fields such as spintronics, orbital ordering, and multiferroics. Surfaces and interfaces are especially interesting in these strongly-correlated electron systems, where the rearrangement of electrical charge resulting from a minimization of surface or interfacial energy can have unexpected and often exciting consequences. Indeed, as the drive to miniaturize devices well below the micron size continues, the fraction of material constituting 'non-bulklike' properties is becoming increasingly significant.

On the other hand, the degree of sophistication needed to understand and predict these complex systems has driven a complementary thrust in theoretical modelling, beginning as long ago as 1963, with Hubbard's addition to the tight-binding model of the formulation of conduction in terms of a hopping integral. The present level of understanding is now so advanced that theory and experiment are no longer so distinct, both gaining further insights from one another.

The aim of this special issue in the *Journal of Physics: Condensed Matter* is to convey to the reader the most up-to-date understanding of the physics of the surfaces, interfaces, and thin films of complex metal oxides, in a clear and accessible manner. The order of the 16 contributions reflects the broad range of disciplines within this field, beginning with general considerations and theoretical models, continuing with film growth techniques and characterization, and concluding with material types and devices.

It is fairly safe to assume that research in this area will enjoy as illustrious and long-lived a future as it has had a past. As such, it is hoped that this contribution will accurately reflect this status in the first decade of the 21st Century and long provide a reference for physicists continuing on this exciting Odyssey.

0953-8984/08/260301+01$30.00 © 2008 IOP Publishing Ltd Printed in the UK