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PREFACE

The new science of oxide interfaces

Over the past decade, a huge range of emergent properties have been demonstrated at the interfaces between complex oxides. Such properties represent a paradigm of 'greater than the sum of parts', with radically different properties to the parent materials being obtained. Hence, oxide interfaces offer the potential to create entirely new functionality, and, in many cases, they do this at room temperature. The most notable example of the recent years is one where electronic reconstruction occurs at interfaces leading to many novel phenomena: two-dimensional electron gases with remarkable properties, superconducting states where the conductivity is confined to a single atomic plane, improper ferroelectric states and interfacial magnetism.

In parallel with these emergent phenomena and perhaps of equal excitement are the novel properties arising from coupling of functions at interfaces, for example mechanical or strain coupling. With these effects comes the possibility to create larger functional effects, or to have high operation temperature, or to have effects in much thicker films, or all three of these. Recent dramatic examples include creation of room temperature magnetoelectrics, creation of high operation temperature, green ferroelectric in micrometre-thick films, electrostatic control of interface states and tunnel electroresistance through ferroelectrics.

Many of the recent discoveries have been enabled by the development of precision thin film growth techniques as well as analytical tools to probe interfacial regions at the nanoscale. In parallel, the rapid development of computational techniques is reaching the stage where complex heterogeneous systems can begin to be explored. However, while interfaces can now be grown with very high structural perfection, there are still remaining questions as to the nature, extent and role played by interfacial defects. Other questions remain about valence states of ions at interfaces, and the level of intermixing.

The Discussion Meeting at the Royal Society was therefore an extremely timely opportunity to encourage a focused in-depth discussion of the properties of and predictions for oxide interfaces. The papers presented at this Discussion Meeting span spintronics, ferroelectrics and superconductivity and demonstrate the frenetic research activity that is driving this field forward.

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One contribution of 10 to a Discussion Meeting Issue 'The new science of oxide interfaces'.