Where Imperfection Means Possibility

Distinguished Professor Elbio Dagotto Co-Edits Book on Oxide Heterostructures

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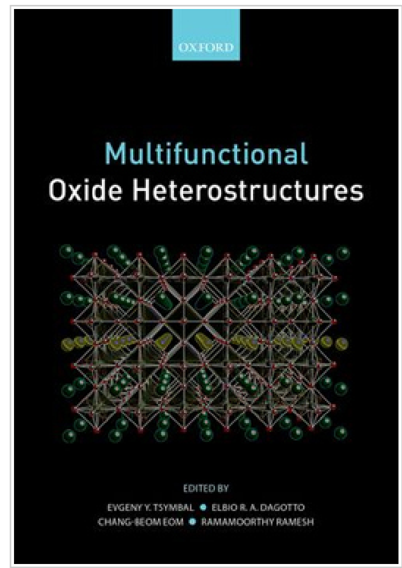

Sometimes great opportunities are realized at the junctions of imperfection; where, although things may not line up perfectly, they offer a much wider and more interesting range of possibilities. Such is the case with oxide materials, the subject of a new text co-edited by UT Distinguished Professor of Physics Elbio Dagotto.

In *Multifunctional Oxide Heterostructures*, top researchers from across the world illuminate the core principles, theoretical models, experimental approaches, and application potential of materials categorized as *oxide heterostructures*. Dagotto is both a co-editor and contributor to the book, which was published August 30 by the Oxford University Press.

Oxide thin-films and heterostructures are a rapidly-growing field in the wider world of materials science, where there is an ever-increasing demand for smaller, smarter, and more powerful materialsparticularly in the realm of electronics. A **January 2012 editorial in *Nature Materials* (http://www.nature.com/nmat/journal/v11/n2/full/nmat3244.html)** noted that oxide materials are finding applications in batteries, fuel cells, and information storage. Of keen interest in recent years have been the transition metal oxides, materials combining oxygen with other elements from the "transition metal" area of the periodic table: copper, titanium, or iron, for example. These compounds possess interesting and useful properties, such as high-temperature superconductivity, that have made investigating them a priority for scientists. Yet the development of next-generation devices depends on revealing the mysteries of these oxide systems, including the best way to grow and characterize them and how their structure influences their properties and potential applications.

Perfectly Imperfect

A material's architecture plays a key role in how it works or responds to external stimuli. Semiconductors and insulators, for instance, have a conduction band (where there are few if any electrons), and a valence band, (where there are many). The gap between these two bands influences whether the material is an insulator, a conductor, or a semiconductor. When two such materials come into contact and their bands don't align at the interface, they form a heterostructure, a rich territory where that imperfection translates into scientific potential. Oxide materials in this formation show a number of interesting properties, including the interplay between magnetism, ferroelectricity, and conductivity. Controlling the interaction between layers gives rise to the possibility of controlling and enhancing those properties. Research in this field holds the promise of novel functions and devices: the 2000 Nobel Prize in physics went to scientists who developed semiconductor heterostructures used in high-speed and opto-electronics.

Dagotto, a condensed matter theorist, is one of four editors of this new book covering the principles, properties, and potential applications of oxide materials and heterostructures. His counterparts are Evgeny Y. Tsymbal (University of Nebraska-Lincoln), Chang-Beom Eom (University of Wisconsin-Madison), and Ramamoorthy Ramesh, (University of California-Berkeley). Dagotto also co-wrote the book's first chapter (A Brief Introduction to Strongly Correlated Electronic Materials) with Yoshinori Tokura of Japan's RIKEN Advanced Science Institute. In this section, the two scientists give an overview of strongly-correlated electronic (SCE) materials, which are typically made of simple building blocks yet form large ensembles that exhibit non-trivial properties such as high temperature superconductivity and colossal magneto-resistance.

Dagotto, who joined the UT faculty in 2004, holds a joint appointment as a Distinguished Scientist at the Materials Science and Technology Division of Oak Ridge National Laboratory. He is a Fellow of the American Association for the Advancement of Science and of the American Physical Society and is author or co-author of more than 300 publications.