Susanne Stemmer

UC Santa Barbara, United States

Thin Film Topological Matter

Since their discovery almost two decades ago, a new class of materials known as topological insulators has generated huge excitement in the condensed matter physics community. One of the characteristics of topological insulators is that while the interior of the material is insulating, their surfaces or edges are conducting. These conducting boundary states have properties that are of great interest for future applications; for example, they may host new electronic states that may enable fault-tolerant quantum computers. So far, many of these ideas have been challenging to realize. For example, as a first step, they require high quality topological insulator thin films that do not exhibit spurious conduction from the materials' interior. Here, we discuss the synthesis of high quality thin films of cadmium arsenide (Cd3As2), which we grow by molecular beam epitaxy. Cd3As2 is known to belong to another class of topological materials, known as three-dimensional Dirac semimetals, but, as we will discuss in this presentation, in thin films it can be tuned between a variety of topological phases. We will discuss the evolution of the electronic states of Cd3As2 films as their thickness is scaled. We show that magnetotransport studies can distinguish between the different topological phases, because in these high-quality films, transport is not obscured by parasitic bulk conduction. Finally, we will discuss routes to new devices with these materials.

Susanne Stemmer is Professor of Materials at the University of California, Santa Barbara. She did her doctoral work at the Max-Planck Institute for Metals Research in Stuttgart (Germany) and received her degree from the University of Stuttgart. Her research interests include scanning transmission electron microscopy techniques, molecular beam epitaxy, strongly correlated oxide heterostructures, and topological materials. Honors include election to Fellow of the American Ceramic Society, Fellow of the American Physical Society, Fellow of the Materials Research Society, Fellow of the Microscopy Society of America, and a Vannevar Bush Faculty Fellowship of the U.S. Department of Defense.