Solution-based, Low-temperature Deposition of Oxide Thin Films for Electronics

Jeremy Anderson, Stephen Meyers, Douglas A. Keszler, Craig Munsee, John Olson, and John F. Wager, Oregon State University, Tran Phung, David C. Johnson, University of Oregon, and Gregory S. Herman Hewlett-Packard Company, Corvallis, Oregon, USA

Abstract

The realization of high-quality oxide thin films for electronics applications through low-temperature solution deposition represents a singular challenge in processing chemistry. Traditionally, such processing has been accomplished through a selected sol-gel process usually involving organic precursors and a hydrolysis reaction. To convert hydrolysis products to oxide and fully eliminate precursor materials, a high-temperature annealing step is included. Of course, this high-temperature anneal diminishes the advantages of a low-temperature solution deposition; it also commonly leads to the occurrence of undesirable morphologies as well as fractured films through the phenomenon of mud cracking. In a thin-film device, it is especially important to be able to control film morphology and produce the desired functionality.

In our work, we are examining new approaches to processing thin oxide films by eliminating organic precursors, identifying new materials systems, developing rapid condensation reactions that promote oxide formation at low temperatures, and investigating the formation and reactions of new nanolaminates. In this presentation, an overview of these approaches will be described with performance characteristics of films in MIM capacitors and transistors serving as examples of the final products.

Author Biography

Douglas A. Keszler is professor and chair of the Department of Chemistry at Oregon State Univeristy. His research interests include programs on the discovery and development of new inorganic thin-film materials for application in the areas of low-cost electronics, transparent electronics, and photovoltaic devices. He is also actively engaged in the the development of nonlinear optical crystals for high-power, deep UV applications and new, efficient phosphors for lighting and displays.