High-Yield Production of Ultralarge $Ba_{0.8}Sr_{0.2}TiO_3$ Capacitors Hinges Upon Pt Dewetting

Cracks. Pinholes. Inclusions. Any of these can be a materials researcher's nightmare foretelling the end to a capacitor. P. Daniels, J. Ihlefeld, W. Borland, and J-P. Maria, however, designed a cost-effective process to develop electrodes that are tolerant of cracks and defects that would normally short circuit a capacitor. Contrary to conventional procedure, they sputter Pt electrodes onto thin-film $Ba_{0.8}Sr_{0.2}TiO_3$ (BST) dielectrics *before* the annealing process that crystallizes and densifies the ceramic layer. During the 900°C anneal, Pt atoms migrate away from microstructural defects but remain wetted to the rest of the film surface. The researchers from North Carolina State University and Dupont Electronic Technologies say the high-yield process can be used with other oxide–metal combinations to manufacture large-scale, low-cost capacitors.

As the researchers describe in their article in the July 2007 issue of the *Journal of Materials Research* (p. 1763; DOI: 10.1557/JMR.2007.0272), "Because the probability of depositing an electrode over such a defect scales with capacitor dimension, limitations in yield [traditionally] can be traced to defect area density." Thus, in the absence of clean room processing, producing millimeter- to centimeter-scale thin-film capacitors is a tremendous challenge. Using the phenomena of Pt dewetting, the group routinely achieved 5-µF capacitors that were 1 µm in thickness and 2.5 cm in lateral dimension. Functional capacitors had a dielectric loss tangent of <0.15 (lower values typically mean better quality capacitors). The procedure provides dramatic yield improvement of large-scale, functional capacitors without using costly clean room environments and specialized equipment to prevent defects.

The success of the procedure hinges upon the naturally high metal–oxide surface energy. Because of the high interfacial energy, thin films of Pt will dewet a dielectric surface at sufficiently elevated temperatures. Daniels and colleagues found that Pt electrodes at least 150-nm thick provide continuous Pt coverage and avoid dewetting and beading during a 900°C anneal. At this Pt thickness and anneal temperature, however, Pt retreats from the immediate vicinity of cracks or surface asperities, which often lead to short circuit pathways and capacitor failure. The researchers hypothesize that high physical curvature at these potential defect sites drives the electrode rearrangement.

The process updates established low-cost fabrication routes to provide high-yield, thin-film capacitors. The researchers believe the success of electrode deposition followed by sintering will apply to capacitors with other metal–oxide combinations having high interfacial energy.

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One-Dimensional Ag Nanoparticle Arrays Formed by Decomposition of Precursor Nanowires

Assembling one-dimensional (1D) nanoparticle arrays is more challenging to achieve than generating other nanoparticle arrays because of their isotropic structure and nondirectional interaction. J. Nishijo and co-workers from the Institute for Molecular Science, Japan, produced diameter-controlled, 1D Ag nanoparticle

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