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Restoration of perovskite phase in the top layer of thin BTO film by plasma treatment and annealing

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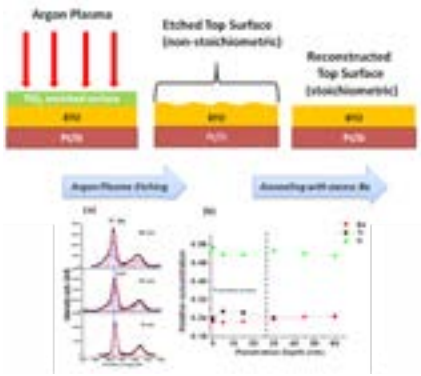
Barium titanate ($BaTiO_3$) is a very attractive material in the field of electroceramics and microelectronics due to its good electrical properties. Its high dielectric constant and low loss characteristics make BTO an excellent choice for many applications, such as capacitors, multilayer capacitors (MLCs) and energy storage devices. In more recent activities, the focus has shifted on growth of thin BTO films with thickness ≤200 nm and preferably even thinner like 100 nm. It is desirable to have thin films of BTO grown on (Pt/Si) that can act as a super capacitor if the relative permittivity is more than 100. However, the growth of thin BTO film (~100 nm) with acceptable dielectric and ferroelectric properties has not been adequately addressed to and the method to grow such a film has not been standardized either. We report a simple method to restore the perovskite phase in the top surface/sub-surface region of a thin film (~100 nm) of barium titanate (BTO) fabricated by pulsed laser deposition on a platinized silicon (Pt/Si) surface and thus enhance its dielectric and ferroelectric properties. Phase evolution, surface morphology with local chemical composition of BTO films have been studied as a function of laser fluence. Investigations using X-ray diffraction (XRD), grazing-angle incidence X-ray diffraction (GIXRD) and depth resolved X-ray photoelectron spectroscopy (XPS) show that even after achieving a good phase formation there can be a presence of non-perovskite TiO_2 phase at the surface and subsurface in such films that degrades its dielectric and ferroelectric response. The restoration of the degraded top layer was done by a combination of low energy Ar plasma treatment followed by an annealing process that enhances Ba content.



Biography

Ankita Ghatak is a Post-doctoral Fellow and has her expertise in growth of nanostructured binary as well as complex oxides. She has grown aligned 1-D nanostructured binary oxide which has a strong influence in the field of applications. She also has her on expertise on microstructural analysis of complex oxide nanostructures that has provided up a new field of research from technological point of view. Her interface analysis of complex materials with substrates has opened a challenging field in the device fabrication process. She in her publications has tremendously contributed about the benefit of creating atomically sharp interfaces that will enhance the future device performances.

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