# MS43. Thin films, stresses and textures

Chairs: Fabiola Liscio, Magali Morales

## MS43-P1 Rapid thermal annealing induced formation of Ge nanoparticles in ZnO thin films: A detailed SAXS study

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In this study, germanium nanoparticles (Ge-np) embedded ZnO multilayered thin films were produced on z-cut quartz and Si substrates by sequential r.f. sputtering of ZnO and d.c. sputtering of Ge targets followed by an ex-situ rapid thermal annealing (RTA) process performed at 600°C for 30, 60, and 90 s. Evolution of Ge-np via RTA process have been investigated in detail especially by using small angle x-ray scattering (SAXS) technique. X-ray diffraction (XRD) patterns showed that fcc diamond phase Ge-np were successfully formed in c-axis oriented ZnO host. Crystallite sizes of diamond phase Ge-np calculated by Scherrer formula were in the range of 18-27 nm. Analysis of SAXS patterns revealed that optimum RTA time at 600°C to form monodispersed Ge-np is 60 s. Moreover, 30 s RTA was inadequate for the complete crystallization and segregation of crystalline Ge-np, 90 s RTA turned out to be improving the crystallite size as well as deteriorating the isolation of Ge-np possibly by inter diffusion of Ge atoms back to ZnO host. These results suggest that RTA applied under certain conditions is a robust and scalable route to form monodispersed well crystallized Ge-np in ZnO multilayered thin films for various applications.

**Keywords:** Ge nanoparticles, ZnO thin film, SAXS, Sputtering.

## MS43-P2 Evidence of Ferroelectricity in La2Zr2O7 thin films with a frustrated pyrochlore-type structure

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Thin films of lanthanum zirconate ($La_2Zr_2O_7$) have been grown by an easy sol–gel route on (110)-oriented $SrTiO_3$ substrates. Electrical measurements, locally performed by piezoresponse force microscopy, evidence unambiguously the ferroelectric state of the films at the nanoscale level. In the $La_2Zr_2O_7$ bulk material, ferroelectricity is absent due to the centro-symmetric cubic pyrochlore structure. In thin films, the extensive study carried out by high resolution X-ray diffraction highlights a lowering of the cubic symmetry that may explain the emergence of ferroelectricity. This slight structural modification is interpreted as a geometrical frustration induced by the substrate's strains during the film growth. In addition, pole figure experiments are used to give epitaxial relationships between the $La_2Zr_2O_7$ film and the $SrTiO_3$ substrate. Finally, high resolution transmission electron microscopy images obtained on a cross-section of the film will be presented.

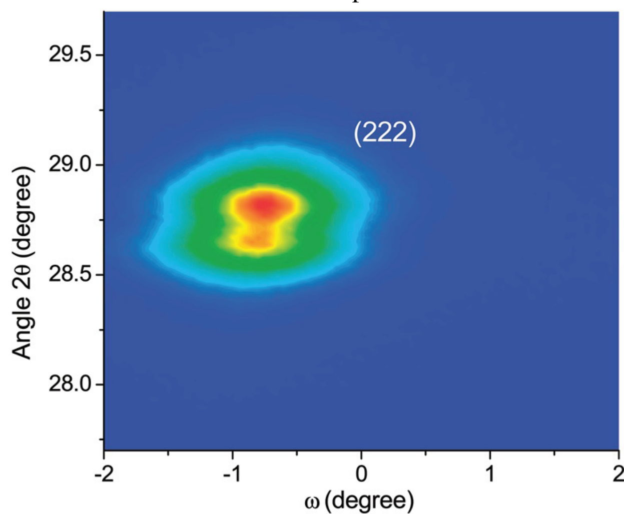


**Figure 1.** Reciprocal space map around the (222) reflection for the $La_2Zr_2O_7$ film grown on the (110)-oriented $SrTiO_3$ substrate

**Keywords:** ferroelectricty, piezoelectric force microscopy, reciprocal space mapping, pole figure