**Nanodomains in ferroelectric / dielectric superlattices : a key role in the structural and functional properties**

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Research on nanoscale ferroelectrics evidences that their behaviour is different from that in bulk ferroelectrics, in particular density of the domains and the domain walls increases and plays a key role in the functional properties. For fundamental physics, ferroelectric/dielectric superlattices constitute fascinating objects to understand ferroelectricity at the nanoscale, and to reveal new phenomena with potential for future devices. By alternating individual ultra thin ferroelectric layers with dielectric layers, it is possible to induce ferroelectric nanodomains1 which are isolated from surface or film-substrate interfaces, and to change the electrostatic domain boundaries as well as the mechanical strain. The polarization discontinuity at the interfaces induces a depolarizing field, and the stability of the polar phase is preserved by forming stripe nanodomains of alternate up and down polarization.

In this talk, we will address some results which illustrate that the presence of ferroelectric nanodomains can lead to the emergence of new phase or can completely change the electric permittivity of a ferroelectric. We will show that a concomitant effect of strains and depolarizing fields in PbTiO3, PbZr0.2Ti0.8O3, SrTiO3 tricolor superlattices can stabilize a monoclinic phase in PbZr0.2Ti0.8O3 layers2. Combined with the electrostatic effect, the tensile strain induced by PbZr0.2Ti0.8O3 in the PbTiO3 layers leads to a polarization rotation associated with a monoclinic Mc phase. In PbZr0.2Ti0.8O3 / SrTiO3 superlattices, we will also show that the ferroelectric capacitance can be stabilized in the negative capacitance region3. Negative capacitance has been proposed as way of overcoming fundamental limitations on the power consumption of field-effect transistors4, and therefore has recently attracted much attention. The negative capacitance was shown to be strongly related to the existence of ferroelectric nanodomains, in particularly, the domain wall motion greatly influences the dielectric properties of the heterostructure5.

**Keywords :** ferroelectric materials, epitaxial superlattices, nanoscale, domain structure, strain and electrostatic effects, negative capacitance effect

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