Electrocaloric effect in low dimensional oxides

Matjaz Valant
Materials Research Laboratory, University of Nova Gorica, Vipavska 11, 5000 Nova Gorica Slovenia

In the polar crystals the net dipole moment and, consequently, the polarization increases with an application of an external electric field. This causes a decrease in entropy of the system and, in turn, an adiabatic increase in temperature. This phenomenon is called the electrocaloric (EC) effect. The driving force for the research of the electrocaloric materials is the quest for the new alternative cooling technologies that would increase the efficiency of the cooling cycle and eliminate the need for the pollutant refrigerants and compressor unit that consumes high amount of energy.

The development of high EC effect bulk materials continues because the high refrigeration capacity that is required for the cooling medium and large-scale cooling facilities can merely be achieved with any other type of materials than ceramics. However, recent discovery of giant EC effect in thin films has turn the attention to low dimensional structures and application such as micro-cyrocoolers. Because of the experimental difficulties many authors have chosen to theoretically investigate the EC effect in low dimensional oxides. The main parameters of the thin films and their influence on EC effect are theoretically well elaborated. This includes mechanical and electrical boundaries (clamping, misfit strain, electric fields), film thickness, orientation related to EC anisotropy etc. Not only for thin films but also for quantum dots, nanoshells, pn-junctions EC effect have already been studied. The main highlights of the talk will be dedicated to the studies of mechanical boundaries, film thickness and origin of giant EC effect.