$Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ ceramics for electrocaloric cooling

Barbara Malič[1,2]
[1]Electronic Ceramics Department, Jožef Stefan Institute,
[2]Jožef Stefan International Postgraduate School
Jamova cesta 39, 1000 Ljubljana, Slovenia
barbara.malic@ijs.si

Increasing needs of society for electricity, heating, or cooling have become a global priority, thus efficient ways of energy production, conversion, storage, and consumption are needed. A contribution to solutions to such problems may be implementation of nonlinear dielectrics (ferroelectrics, relaxor ferroelectrics, antiferroelectrics) in cooling by exploiting the electrocaloric effect (ECE). The latter is defined as a reversible temperature change in a material upon application of an external electric field at adiabatic conditions [1]. Materials exhibiting a large ECE over a temperature range of a few 10 K close to room temperature include lead-based complex perovskites, such as $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN) and PMN-rich PMN-$PbTiO_3$ (PMN-PT) solid solutions [2, 3], exhibiting a pronounced relaxor character.

In the contribution we discuss different effects introduced by the choice of the synthesis and processing and evidenced in the microstructure which are reflected in the electrocaloric response of bulk ceramic materials. The viability of multilayer cooling elements with the tailored composition and microstructure [4,5] is assessed from the point of view of application in demonstrator devices.

References

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