Dynamics of domains switching in epitaxial BaTiO$_3$/SrTiO$_3$ superlattices from first principles$^1$ SERGEY LISENKOV, INNA PONOMAREVA, LAURENT BELLAICHE, University of Arkansas — Superlattices (SL) consisting of alternating layers of perovskite oxides can possess properties that are dramatically different from those of bulk ferroelectrics. [BaTiO$_3$]$_n$/[SrTiO$_3$]$_n$ (BT/ST) SL with relatively large periods exhibit novel nanostripe domains for some specific epitaxial strains and within a particular temperature window [1]. Here, an effective Hamiltonian approach is used within molecular dynamics method to predict the evolution of these nanostripe domains in BT/ST SL under an ac electric field applied along the SL growth direction. For any investigated frequency, four different regions occur, depending on the magnitude of the electric field: Region I that consists of nanostripe domains in both BT and ST layers; Region II that exhibits nanostripe domains in BT layers while possessing monodomains in ST layers; Region III where bubble domains in BT layers coexist with monodomains in ST layers; and Region IV where monodomains form in both BT and ST layers. The dependency of the domain velocities, activation and critical fields on the field frequency is revealed.


$^1$Supported by NSF grants DMR-0404335,DMR-0080054,DMR-0701558, by ONR grant N00014-04-1-0413,by DOE grant DE-FG02-05ER46188

Sergey Lisenkov
Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701, USA

Date submitted: 20 Nov 2007

Electronic form version 1.4