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Equilibrium Polarization under Ionic Surface Compensation in Ultrathin PbTiO$_3$ M.J. HIGHLAND, T.T. FISTER, D.D. FONG, J.A. EASTMAN, S.K. STREIFFER, P.H. FUOSS, G.B. STEPHENSON, Agronne National Laboratory, Argonne, Illinois 60439, USA, CAROL THOMPSON, Department of Physics Northern Illinois University, Dekalb, Illinois 60115, USA — The polarization structure of a ferroelectric film depends strongly on the charge compensation at its interfaces. When there is no electrode, ions from the environment can compensate a surface. We have previously shown that changing the chemistry of the environment can drive polarization switching in a ferroelectric film, and for the thinnest films the switching occurs continuously, without domain nucleation. In this talk we present results on the equilibrium polarization of a film as a function of the ionic compensation of its surface. Synchrotron x-ray scattering is used to determine the polarization structure of epitaxial PbTiO$_3$ films on conductive SrRuO$_3$ layers coherently strained to SrTiO$_3$ (001) substrates as a function of temperature, film thickness, and external oxygen partial pressure (pO$_2$). We observe a suppression of the Curie temperature (T$_C$) at intermediate values of pO$_2$, which becomes very large for films thinner than $\sim$5 nm. This suppression of T$_C$ is explained by a model for the equilibrium between the chemical environment and the surface of the ferroelectric. Work supported by the U. S. Department of Energy under Contract No. DE-AC02-06CH11357.

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