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Polarization current as evidence of local anticlinic correlations in de Vries smectics[1] Z. V. SMITH, P. D. BEALE, R.-F. SHAO, L. WANG, D. M. WALBA, N. A. CLARK, M. A. GLASER, LCMRC, U. of Colorado, Boulder — Previous theoretical work on the electroclinic response of chiral de Vries SmA materials based on the electric field-induced reorientation of independent tilt domains [J. V. Selinger et al., Phys. Rev. E 64, 061705 (2001)] fails to account for the sigmoidal dependence of induced polarization (P) on field (E) seen in some materials. To account for this behavior, we model de Vries smectics as ensembles of small but finite anticlinic tilt domains. Within each domain, interlayer tilt coupling favors anticlinic interfaces, but the finite range of in-layer tilt correlations leads to thermally activated synclinic interfaces and a finite tilt correlation length along the layer normal. This model, equivalent to a generalized one-dimensional XY model in an external field with quadratic and quartic nearest-neighbor interactions, is studied by Monte Carlo simulation and transfer matrix methods. The model successfully reproduces the dependence of P on E for a specific material (W530), and yields physical parameters such as the in-layer correlation length and effective interlayer tilt coupling. The predicted anticlinic tilt correlations should be observable as diffuse superlattice reflections in polarized resonant x-ray scattering experiments.

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Joseph Maclennan
Dept. of Physics, U. of Colorado, Boulder

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