Magnetic and orbital order in (RMnO3)n/(AMnO3)2n superlattices

SHUAI DONG, University of Tennessee, Knoxville; Oak Ridge National Laboratory; Southeast University, China, QINFANG ZHANG, Yancheng Institute of technology, China, ELBIO DAGOTTO, University of Tennessee, Knoxville; Oak Ridge National Laboratory — The magnetic and orbital orders in (RMnO3)n/(AMnO3)2n (R: rare earths; A: alkaline earths, n=1 and 2) superlattices have been studied using both the double-exchange model and density functional theory calculations. For large bandwidth manganites, the A-type antiferromagnetic order is found to be robust when the superlattices are grown on a SrTiO3 substrate, as in recent experiments on (LaMnO3)n/(SrMnO3)2n. In addition, a C-type antiferromagnetic state is predicted for these superlattices when using substrates like LaAlO3 with smaller lattice constants. The physical mechanism for the stabilization of the A- and C- magnetic transitions is driven by the orbital splitting of the x2-y2 and 3z2-r2 orbitals, which is induced by the Q3 mode of Jahn-Teller distortions created by the strain induced by the substrates. If the superlattices were prepared employing narrow bandwidth manganites, several non-homogeneous magnetic profiles are predicted to exist, highlighting the importance of carrying out investigations in this mostly unexplored area of research. [1] S. Dong, Q.F. Zhang, S. Yunoki, J.-M. Liu, and E. Dagotto, Phys. Rev. B in press. (ArXiv: 1211.1943) [2] Q.F. Zhang, S. Dong, B.L. Wang, and S. Yunoki, Phys. Rev. B 86, 094403 (2012).

1Supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Materials Sciences and Engineering Division.

Shuai Dong
University of Tennessee, Knoxville; Oak Ridge National Laboratory; Southeast University, China

Date submitted: 27 Nov 2012 Electronic form version 1.4