Band gap engineering in digital manganite-titanate superlattices

XIAOFANG Zhai, CHANDRA MOHAPATRA, Department of Physics, University of Illinois at Urbana-Champaign, AMISH SHAH, JIAN-MIN ZUO, Department of Materials Science Engineering, University of Illinois at Urbana-Champaign, ZORAN POPOVIC, SASHI SATPATHY, Department of Physics, University of Missouri, Columbia, ANAND BHATTACHARYA, Argonne National Lab, JAMES ECKSTEIN, Department of Physics, University of Illinois at Urbana-Champaign — The electronic structure of short period digital superlattices of two different phases depends strongly on the superlattice architecture. We have fabricated digital superlattices of super cells consisting of N layers of LaMnO$_3$ and N layers of SrTiO$_3$, $N=1, 2, 3, 8$, and measured their optical conductivities to probe the way in which the electronic structure depends on N. We found the valence band structure systematically changes, as N decreases, from bulk like band gaps to interface modified band gaps. The temperature dependence of the derived Mn Jahn-Teller/Mott gap in large period superlattices is completely different from the small period, suggesting different spin ordering states reside in them. The electronic structure of two parent materials are coherently blended at the interface, and the spin ordering is strongly modified. This method of producing meta materials is a promising new way of material engineering.

This work is supported by Department of Energy and the Frederick Seitz Materials Research Laboratory.

Xiaofang Zhai
Department of Physics, University of Illinois at Urbana-Champaign

Date submitted: 27 Nov 2007

Electronic form version 1.4