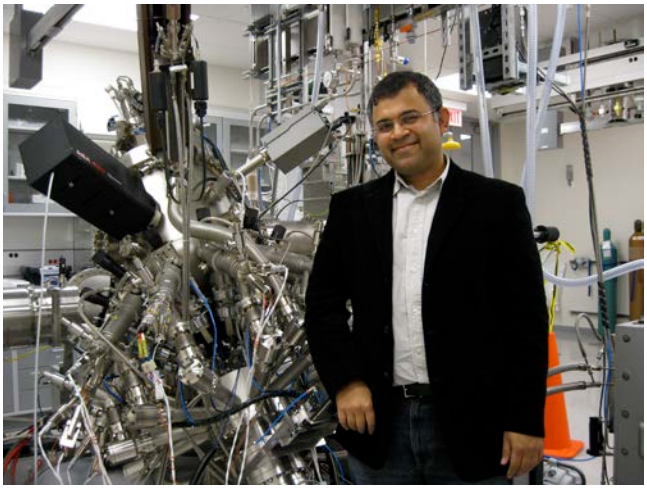

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Research Summary:

The complex oxides have been fertile ground for strong correlations, giving rise to properties that range from high-temperature superconductivity to room temperature multiferroic behavior. In my research program, we explore new ways to realize and manipulate collective states in the complex oxides. Our approach can be broadly classified into two themes: (i) Interfaces between complex oxides where the electronic and lattice degrees of freedom may 'reconstruct', and lead to novel collective states. (ii) Nanoscale confinement of complex oxides, including phase separated materials. We synthesize our materials in atomic layer-by-layer manner using an ozone-assisted oxide-MBE system, which I designed. This technique allows us to create heterostructures and superlattices with atomically sharp interfaces between constituent materials. We bring to bear a variety of tools that probe the states that arise in these structures, including transport and magnetic measurements, scattering with neutrons and x-rays, and scanning probes.

Selected Recent Publications:

"Delta Doping of Ferromagnetism in Antiferromagnetic Manganite Superlattices", T.S. Santos, B.J. Kirby, S. Kumar, S.J. May, J.A. Borchers, B.B. Maranville, J. Zarestky, S. G. E. te Velthuis, J. van den Brink, and A. Bhattacharya, *Phys. Rev. Lett.* **107**, 167202 (2011).

"Enhanced ordering temperatures in antiferromagnetic manganite superlattices", S. J. May, P. J. Ryan, J. L. Robertson, J.-W. Kim, T. S. Santos, S. G. E. te Velthuis, E. Karapetrova, J. L. Zarestky, J. N. Eckstein, S. D. Bader, and A. Bhattacharya, *Nature Materials* **8**, 892 (2009).

"Tuning between the metallic antiferromagnetic and ferromagnetic phases of $La_{1-x}Sr_xMnO_3$ near x=0.5 by digital synthesis", T. S. Santos, S. J. May, J. L. Robertson and A. Bhattacharya, *Physical Review* B **80**, 155114 (2009).

"The metal-insulator transition and its relation to magnetic structure in $(LaMnO3)_{2n}/(SrMnO3)_n$ superlattices". A. Bhattacharya, S. J. May, S. G. E. te Velthuis, M. Warusawithana, X. Zhai, A. B. Shah, J.-M. Zuo, M. R. Fitzsimmons, S. D. Bader, J. N. Eckstein, *Physical Review Letters* **100**, 257203 (2008).

"Electronic Reconstruction at $SrMnO_3$-$LaMnO_3$ Superlattice Interfaces" Serban Smadici, Peter Abbamonte, Anand Bhattacharya, Xiaofang Zhai, Bin Jiang, Andrivo Rusydi, James N. Eckstein, Samuel D. Bader, and Jian-Min Zuo, *Physical Review Letters* **99**, 196404 (2007).

"Electrostatic modification of novel materials", C. H. Ahn, A. Bhattacharya, M. di Ventra, J. N. Eckstein, C. Daniel Frisbie, M. E. Gershenson, A. M. Goldman, I. H. Inoue, J. Mannhart, A. J. Millis, A. F. Morpurgo, D. Natelson, J-M. Triscone, *Reviews of Modern Physics* **78**, 1185 (2006).