Charge Transfer and lattice strain at Oxide Interfaces: emergent Mottness, multiferroicity and antisite defects

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Interfaces separating transition metal oxide materials of different functionalities have the potential to host novel and potentially behavior. Understanding how to design interfaces that optimize desired properties while minimizing the potential for undesirable effects is an important research goal. In this talk I highlight the important roles of substrate-induced strain and across-interface charge transfer in controlling the properties of transition metal oxide-based superlattices. Charge transfer is controlled by the relative electronegativities of the transition metal ions while strain is controlled by the substrate. I give examples of how charge transfer and strain may lead to desirable properties including emergent Mott insulating behavior [1] and multiferroicity [2] as well as undesirable properties including antisite defects [3]. Strengths and weaknesses of calculational methods are outlined [4]. This work was performed in collaboration with Hanghui Chen and supported by DOE ER-046169 and NSF-DMR-1120296.

[1] Phys. Rev. Lett. 111, 116403 (2013)
[2] Phys. Rev. B 94 165106 (2016)
[3] Phys. Rev. B93, 104111 (2016).
[4] Phys. Rev. B 93, 045133 (2016)

Andrew Millis works in theoretical condensed matter physics, with an emphasis on strongly correlated electron systems. He obtained his A. B. degree in Physics from Harvard University in 1982, and his Ph.D. degree in Physics from MIT in 1986. From 1986-96 he worked in the theory group at AT & T (later Lucent Technologies) Bell Laboratories, and then held faculty positions at the Johns Hopkins University and Rutgers University before joining Columbia University in 2001, where he is currently Professor of Physics and served as Department Chair 2006-2009. He is also the Associate Director for Physics at the Simons Foundation. Professor Millis is a Fellow of the American Physical Society and the American Association for the Advancement of Science and has served as Gastprofessor at the University of Bonn (1996) and Professeur Invitee at the College de France (2015).

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