Colloquium

Layer by Layer Engineering of Complex Oxide Heterostructures: New Materials and Devices

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Room 118 Nieuwland Science Hall
Refreshments @ 3:30 in 202 NSH

Many complex oxide phases grow layer by layer and can be connected to other compounds in single crystal heterostructures with nearly perfect interfaces using molecular beam epitaxy. Artificial materials can be assembled with novel properties coming directly from the chemical architecture. These include samples with broken inversion symmetry, new optical absorption bands and modulated carrier density controlled on a sub-nanometer scale. I will describe in the case of cuprates how such growth happens and give two examples that show highly unusual physics emerging at samples engineered in this way. In one case, thermodynamically unstable phases can be frozen in place by employing layer by layer growth. Furthermore, the charge and electrostatic potential profile can be adjusted such that a single unit cell contains stacks of CuO2 planes that are superconducting, insulating and then finally superconducting again, forming a tunnel junction embedded within one artificial molecular layer. In the second case I will show that at perfect interfaces between copper oxygen planes *edge-on* connected to insulating $CaTiO_3$ the superconducting density of states develops a dramatic antisymmetry right at the chemical potential, unlike anything seen in other superconductors. This only happens at single crystal a-axis interfaces. The chemically most perfect samples show the strongest asymmetry.

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