Gate-tunable superconductivity in the AlOx/SrTiO3 heterostructure

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SrTiO3-based two-dimensional electron gases (2DEGs) have led to important discoveries [1,2] about superconductivity in low dimensions, such as the observation of pairing interactions without superconductivity [3] and density-of-states features resembling the pseudogap in cuprates [4].

We have devised a method for the facile realization of a 2DEG by the creation of oxygen vacancies (Rodel et al., Advanced Materials 28,1976 (2016)). The deposition in ultra-high vacuum of a thin layer of metallic Al on SrTiO3 leads to the creation of a 2DEG due to the withdrawal of oxygen atoms from the surface by the reducing agent Al (which turns into insulating AlOx).

Transport experiments show that the 2DEG is superconducting with a critical temperature of 320 mK. The critical parameters (temperature and field) are tunable with the gate voltage, leading to a 'superconducting dome' in the phase diagram. The possibility of continuously varying the carrier density allows us to study different equilibrium and non-equilibrium features characterizing the electronic phases. Results of some recent experiments will be presented.