Reconfiguring functional oxides in atomically controlled thin films

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Consumer electronics and electronics is driven by low cost, reliable performance and low energy consumption. To truly enable innovations, new solutions have to be found in new materials. Oxides show multiple functional properties and therefor offer multiple solutions in one material. Moreover, the reconfiguring functionality of materials by using epitaxy or self-assembly etc. (e.g., non-magnetic to ferromagnetic, dielectric to piezoelectric properties or insulating to metallic) has been demonstrated. The success of reconfiguring many of these oxides critically depends on the atomically controlled thin film deposition techniques such as pulsed laser deposition but till now typically laboratory scale single crystalline wafers have been used. Important progress has been made in terms of plasma scanning techniques on large wafers and compatibility with technical materials (Si). However, fundamental knowledge of a scanning plasma and the composition of the thin films, which is essential in obtaining reliable reconfigured functional properties, is lacking.

In this presentation I will discuss examples of manipulation of (magnetic) properties in thin films and the possibility of reconfigurable functionality, in particular on technical wafers such as Si. We showed how to manipulate magnetic and electronic anisotropic properties in manganite heterostructures by engineering the oxygen network on the unit-cell level. In addition, the critical temperature of the metal-to-insulator transition as well as the magnetic transition temperature in $RENiO_3$ can be tuned by choosing spacer layers with different amounts of octahedral tilts in a superlattice configuration. In addition, I will briefly discuss the latest results of oxide thin film and superlattices grown on buffered Si.

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