

Title: Epitaxial Oxides on Silicon for Nanoelectronic Applications

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The ability to integrate crystalline metal oxide dielectric layers into silicon structures can open the way for a variety of novel applications which enhances the functionality and flexibility ranging from high-*K* replacements in future MOS devices to oxide/silicon/oxide heterostructures for nanoelectronic application in quantum-effect devices. We present results for crystalline gadolinium oxides on silicon grown by solid source molecular beam epitaxy. The dielectric properties of such oxides are sensitive to small variations in structure and symmetry. It is known that thin layers of crystalline rare earth oxides can exhibit significant larger dielectric constants compared to bulk materials. We will explain these effects by strain induced structural phase deformations. First, we will report on the dependence of the dielectric constant on layer thickness for epitaxial Gd_2O_3 on Si(111). Controlling the oxide composition in ternary $(Gd_{1-x}Nd_x)_2O_3$ thin films enables us to tune the lattice mismatch to silicon, and thus the strain-induced variation in the dielectric constants of the layer.
We will finally demonstrate different approaches to grow Si nanostructures embedded into crystalline rare earth oxides. By efficiently exploiting the growth kinetics one could create nanostructures exhibiting various dimensions, ranging from three dimensionally confined quantum dots to the quantum wells, where the particles are confined in one of the dimensions. Double-barrier structures comprising epitaxial insulator as barriers and Si as quantum-well are attractive candidate for resonant tunneling devices. Embedded Si quantum dots exhibit excellent charge storage capacity with competent retention and endurance characteristics suitable for nonvolatile memory device applications.

Biography

H. Jörg Osten studied physics in Poland. First he was working at the Institute for Physical Chemistry in Berlin in the field of radio-frequency spectroscopy. In 1988, he joined the Institute of Semiconductor Physics (IHP) in Frankfurt(Oder)/Germany. In 2002, he became the director of the Institute Electronic Materials and Devices at the Leibniz University of Hannover/Germany, where he also holds a chair for electronic materials and technology.
He published more than 270 papers and gave more than 80 invited and 200 contributed talks at international conferences.

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