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Heterostructures by inserting Oxygen Monolayers in Si: 2D Nanolattice Growth, Electronic properties and MOSFET Device Characteristics[1] SUSEENDRAN JAYACHANDRAN, KOEN MARTENS, AUGUSTIN LU, imec / KULeuven, KENGO NISHIO, AIST, GEOFFREY POURTOIS, imec / KULeuven, ANNELIES DELABIE, MATTY CAYMAX, imec, MARC HEYNS, imec / KULeuven — We discuss how heterostructures can be created in silicon by inserting oxygen monolayers, as well as what Density Functional Theory simulations predict in terms of electronic properties of these 2D nanolattices. We also discuss the experimental electrical characteristics of Metal-Oxide-Semiconductor Field Effect Transistors with 2D nanolattice channels. By using short (up to 500ms) low temperature O_3 reaction on H-terminated Si, the deposited O content can be controlled near the monolayer level, as demonstrated by SIMS measurements. Epitaxial deposition of Si on an O layer and 2D nanolattices with up to 5 periods have been achieved by CVD using SiH_4 at 500C. We discuss the structural and electronic properties calculated with density functional theory and give an overview of the most promising Si superlattices in terms of anticipated mobility enhancement. We report on the electrical device characteristics of 2D nanolattice Schottky diodes, MOS capacitors and MOSFETs. We discuss the impact of defectivity on electrical characteristics and the impact of the 2D nanolattices on MOSFET carrier mobility.

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