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Structural and electronic properties of epitaxial graphene on SiC(0001): Growth, transfer doping and atomic intercalation

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Epitaxial graphene on SiC(0001) promises a scalable graphene technology. Growth methods and experimental techniques for layer counting will be reviewed. The graphene layers are n-doped due to the influence of a covalently bonded carbon interface layer. This doping level can be precisely tailored and completely neutralized by functionalizing the graphene surfaces with electronegative molecules. In particular the Fermi level can be shifted into the band gap of bilayer graphene. The influence of the interface can be completely eliminated by hydrogen intercalation. Hydrogen migrates under the interface layer, passivates the underlying SiC layer and decouples the graphene from the substrate. The interface layer alone transforms into a quasi-free standing monolayer and epitaxial monolayer graphene turns into a decoupled bilayer. By intercalation of Germanium the graphene layers can also be decoupled. In this process both p- and n-doping can be obtained, depending on the amount of Ge intercalated. Both phases can be prepared simultaneously on the surface, so that lateral p-n junctions can be envisioned.