Reversible transition between (10×10) and (11×11) phases of Pb intercalated EG on 6H-SiC(0001)

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The intercalation of metals beneath graphene offers a powerful route to stabilizing and protecting novel 2D phases. Epitaxial graphene (EG) obtained by intercalation of a buffer layer on 6H-SiC(0001) with Pb atoms is the subject of intensive experimental [1,2] and theoretical studies [3] due to its charge neutrality, the band gap opening and proximity superconductivity. We performed a detailed intercalation study of Pb beneath the ZLG on SiC(0001) using low-energy electron diffraction (at the temperatures from 70 K to 600 K, Fig. 1) as well as scanning electron, dark field imaging photoemission electron and tunneling microscopy [4]. Importantly, the degree and ease of intercalation strongly depended on the defect density of the initial buffer layer.

Our analysis revealed the formation of different 2D Pb monolayer phases, such as stripes and hexagons, which emerge due to the interplay between substrate pinning and strain within the Pb layer, depending on local coverage. The interface reconstruction of Pb can be *reversibly* tuned by varying the details of the intercalation protocol within the periodicity range from $(9\times9)_{Gr}$ to $(13\times13)_{Gr}$.

Based on our experiments combined with recent simulations [5], an intercalation model, accounting for the different periodicities observed in the interface layer, was proposed. These findings provide new insights into the strain-driven stabilization of intercalated metal layers and highlight the potential of graphene as a versatile platform for engineering low-dimensional materials.

References:

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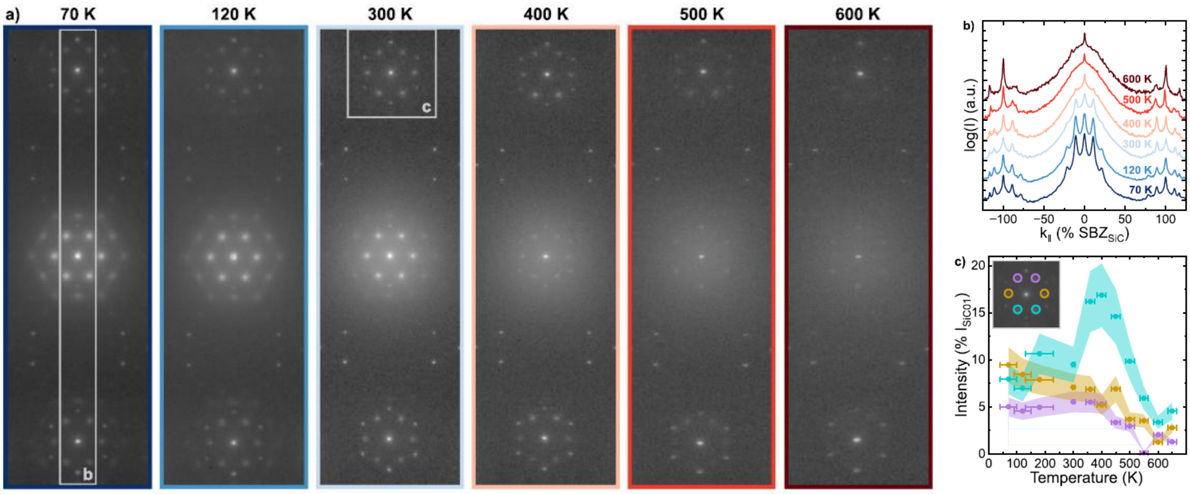

Fig. 1: a) Section of normalized SPA-LEED images along $k_{\parallel,\mathrm{SiC}}$ taken at E = 168 eV at various temperatures. The box in the 70 K measurement marks the direction and averaging width of the extracted line profiles plotted in b). A constant offset is added for better visibility. While the quasi-$(10\times10)_{Gr}$ reflexes completely vanish at 500 K, two Pb diffraction spots reach maximum intensity relative to the SiC(10) reflex at 400 K. The intensity plot in c) reveals a significant difference in the temperature dependence of the Pb spots around SiC(10). The intensity maxima can be associated with first-order diffraction spots of one α-Pb domain rotated by 3.7° w.r.t. $k_{\parallel,\mathrm{SiC}}$.