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The role of two-dimensional pressure in sulfur intercalation underneath graphene on ruthenium — •Lars Buss[1,2], Jens Falta[2], Moritz Ewert[1], Bin Shao[3], Tim Wehling[4], and Jan Ingo Flege[1] — [1]Applied Physics and Semiconductor Spectroscopy, BTU Cottbus-Senftenberg, Cottbus, Germany — [2]Institute of Solid State Physics, University of Bremen, Bremen, Germany — [3]Beijing Computational Science Research Center (CSRC), Beijing, China — [4]Institute for Theoretical Physics, University of Bremen, Bremen, Germany

Micrometer-sized single-layer graphene can epitaxially be grown on transition-metal substrates with excellent crystalline quality. However, due to strong binding these substrates have a detrimental influence on the intrinsic properties of the graphene. By lifting the interlayer coupling, e. g., via intercalating foreign atoms, its unique electronic properties can be restored. We have investigated the intercalation of sulfur underneath graphene on Ru(0001) with low-energy electron microscopy (LEEM) and micro-diffraction (μLEED). We find that sulfur deposited at elevated temperatures enters through the edge of the island, leading to wrinkle formation in the decoupled graphene. Interestingly, the presence of the graphene limits the possible S/Ru(0001) reconstructions that may form underneath, preventing less dense reconstructions like the p(2×2) and ($\sqrt{3}\times\sqrt{3}$) reconstructions. Based on density functional theory calculations, these findings are explained by a 2D pressure exerted by the overlying graphene, which results from the strong graphene-substrate interaction, only rendering the denser reconstructions of the S/Ru phase diagram energetically favorable.

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Email: bussl@b-tu.de