Phase Engineering and Light-Matter Interaction in Two-Dimensional Silver

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Unlike traditional three-dimensional metals, 2D metals exhibit exceptional electronic, optical, and quantum properties due to their reduced dimensionality. However, they are unstable and prone to oxidation. The Confinement Heteroepitaxy technique enables the growth of large-scale, air-stable 2D metals with a gradient bonding character, non-centrosymmetric structure and unique properties, including superconductivity. The metal films intercalate in the epitaxial graphene/silicon carbide interface where the metal templates the SiC lattice, and the graphene film protects it from oxidation. 2D Silver is semiconducting and exhibits two phases with different packing densities, 3:3 (Ag_1) and 4:3 (Ag_2), with varying electrical and optical properties. Our work demonstrates that by changing the type of defects in graphene, we can preferentially intercalate a particular phase. Starting with a buffer layer graphene with predominantly sp^3 defects, we get the Ag_2 phase in the buffer regions and the Ag_1 phase in the monolayer graphene regions, leading to a large area Ag_2 sample. On the other hand, treating graphene with a He plasma treatment leads to line defects, which enable selective growth of the Ag_1 phase after intercalation. These phases exhibit starkly different optical absorption and saturation despite a minimal difference in structure, enabling their possible use in chemical sensors and electronic and optical devices.

NOTE: Word limit 500 words