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Synthesis and Properties of Group IV Graphane Analogues

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Similar to how carbon networks can be sculpted into low-dimensional allotropes such as fullerenes, nanotubes, and graphene with fundamentally different properties, it is possible to create similar ligand terminated sp^3-hybridized honeycomb graphane derivatives containing Ge or Sn that feature unique and tunable properties. Here, we will describe our recent success in the creation of hydrogen and organic-terminated group IV graphane analogues, from the topochemical deintercalation of precursor Zintl phases, such as $CaGe_2$. We will discuss how the optical, electronic, and thermal properties of these materials can be systematically controlled by substituting either the surface ligand or via alloying with other Group IV elements. Additionally, we have also developed an epitopotaxial approach for integrating precise thicknesses of germanane layers onto Ge wafers that combines the epitaxial deposition of $CaGe_2$ precursor phases with the topotactic interconversion into the 2D material. Finally, we will describe our recent efforts on the synthesis and crystal structures of Sn-containing graphane alloys in order to access novel topological phenomena predicted to occur in these graphanes.