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Germananes: Germanium Graphane Analogues

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Graphene's success has shown that it is not only possible to create stable, single-atom thick sheets from a crystalline solid, but that these materials have fundamentally different properties than the parent material. Our interest focuses on the synthesis and properties of Group IV graphane analogues. We have synthesized for the first time, mm-scale crystals of a hydrogen-terminated germanium multilayered graphane analogue (germanane, GeH) from the topochemical deintercalation of $CaGe_2$. This layered van der Waals solid is analogous to multilayered graphane. The surface layer of GeH only slowly oxidizes in air over the span of five months, while the underlying layers are resilient to oxidation. We demonstrate that it is possible to covalently terminate the external surface with organic substituents to tune the electronic structure, and enhance the stability. These materials represent a new class of covalently terminated graphane analogues having great potential for a wide range of optoelectronic and sensing applications, especially since theory predicts a direct band gap of 1.53 eV and an electron mobility of 18,000 cm2/Vs which is five times higher than that of bulk Ge.