

Since the successful synthesis of graphene and discovery of its remarkable characteristics, such as high carrier mobility, strong mechanical parameters, and optical transparency, a great inquiry for other two-dimensional (2D) monolayers is in the agenda of many scientists around the world. Current research focuses on 2D layered or elemental materials with unique properties. However, non-layered 2D compounds can exhibit unusual electronic properties. Group IV and V monolayers are very crucial 2D materials for their high carrier mobilities, tunable band gaps, and optical linear dichroism. Here, motivated by a recent experiment, we show that non-layered group IV-V hexagonal binary monolayers can be stabilized in free-standing form by hydrogenation and show strong spin-orbit interaction and exhibit high electron-hole asymmetry. Their semiconducting nature with diverse band gaps make them potential candidates for optoelectronic, thermoelectric and photocatalyst applications.