Chemistry and applications of monoelemental 2D materials beyond graphene

Zdenek Sofer, Jiří Šturala, Tomáš Hartman, Jan Luxa, Vlastimil Mazánek, Ksenia Mosina
Dept. of Inorganic Chemistry, University of Chemistry and Technology Prague, Technicka 5, 166 28 Prague 6, Czech Republic
zdenek.sofer@vscht.cz

Beyond carbon with most explored 2D material, graphene, are in the 14th group of elements also silicon, germanium, tin and lead. In comparison to carbon, the stable allotropes of these elements posses three-dimensional structures like cubic for silicon and germanium or tetragonal for tin. In order to get these elements in layered structure new top-down and bottom-up approach must be applied. For the bottom-up methods the UHV deposition is most broadly used providing one atom thick isolated island on various substrates. On the other hand, top-down methods offering scalability and access to free standing isolated sheets of two dimensional silicon and germanium (silicene and germanene) and their derivatives. The main approach for silicene and germanene and their derivatives is topochemical exfoliation of Zintl phases containing layers of silicon and germanium atoms stacked in between germanium atoms. Various methods of exfoliation and functionalization of germanene and silicene derivatives will be shown. The methods showing different approach to functionalize silicene and germane are show on Figure 1. The synthesis approaches can be based on direct chemical exfoliation of parent Zintl phase ($CaSi_2$, $CaGe_2$) as well as multi-step functionalization using hydrogenated counterpart (silicane, germanane). In addition, the chemical exfoliation of other Zintl phases producing 2D structures of silicene-germanene solid solution and complex structures like AlGe layers will be shown.

Figures

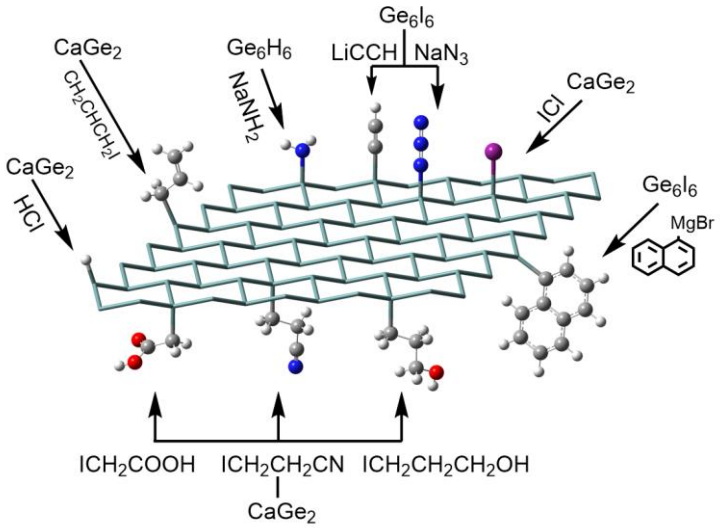

Figure 1: Figure(s) caption(s) (Calibri 11)