Discovery of New Two-dimensional van der Waals Materials; Layered Zintl phases

Department of Energy Science, Sungkyunkwan University

SungWng Kim

kimsungwng@skku.edu

The discovery of new families of two-dimensional (2D) van der Waals (vdW) layered materials has always attracted great attention to pursue beyond graphene. It has been challenging to artificially develop the van der Waals bonded layer structure that is constructed by the stacking of honeycomb atomic lattice composed of two elements as in hexagonal boron nitride. In this talk, a new class of 2D vdW materials, layered Zintl phases will be introduced. These new 2D layered Zintl phases can allow unlimited extent of 2D science in terms of the diversity of materials and their physical properties. A new class of 2D materials was developed from a 3D structured material that has (1) a multicomponent system, (2) primary atomic bonds in three-dimensionality, (3) thermodynamic and chemical stability, and (4) diversity in chemical compositions. Through the dimensional manipulation of crystal structure, we create an unprecedented 2D vdW zinc antimonide (2D-ZnSb), which is the layered Zintl phase with sp^2-hybridized bonding characters in Zn-Sb honeycomb atomic layers. The vdw layered structure of 2D-ZnSb is evolved by selectively etching the lithium cations from the layered LiZnSb Zintl phase that is formulated by alloying the lithium atoms into sp^3-hybridized bonded three-dimensional ZnSb (3D-ZnSb), demonstrating the bidimensional polymorphism of 3D- and 2D-ZnSb. The recent experimental and theoretical studies on diverse physical properties obtained in the new 2D materials will be discussed.