Single Crystalline Transition Metal Dichalcogenide Nanostructures for Energy Applications

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Following the discovery of graphene and the advent of other layered two-dimensional (2D) materials, considerable attention has been directed towards the rich spectrum of properties that 2D material system offers. To date, however, observations of such layered structures have been limited to the 2D system. Here I report the synthesis of high-yield, single-crystalline 1D nanostructure of layered ditellurides using simple solution-phase reactions with low temperatures and short reaction times. The use of Te-rich eutectic metal alloys eliminates the issues of Te deficiency in the resulting products and the impurity contamination encountered for chemical vapor deposition. As a result, the synthesized 1D binary and ternary products of ditellurides are highly pure, stoichiometric, and structurally uniform with a rectangular cross section. Particularly, the most of the products are free from dislocations and defects. In addition, suppression of phase separation in ternary ditellurides is observed across the entire compositional range by virtue of the low growth temperature and the ability of the 1D morphology to accommodate strain-relaxed growth. I will also present on-going research at UNIST, especially on the energy applications of the 1D ditellurides.