Elemental Phosphorus Single Crystals: Growth and Applications

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As the 13th discovered element in the present periodic table, phosphorus is extraordinary because of its remarkable variety of allotropes. Among all the known phosphorus allotropes, black phosphorus (BP) is the most stable one under ambient conditions while red phosphorus (RP) is much abundant, easily available at low cost, chemically stable, and environmentally friendly. Recently, both BP and RP have aroused the interest of a growing number of chemists and materials scientists because they present fascinating properties due to their unique 2D and quasi-1D structure, respectively. In this talk, we report the growth of BP single crystals and fibrous RP single crystals by using the chemical vapor transport reaction [1-3]. We also present the synthesis of quasi-monolayer BP, amorphous BP and Form II crystalline RP by using wet-chemical reaction method [4-6]. The applications of these elemental phosphorus materials in microelectronic device [2], visible-light-driven photocatalytic H_2 evolution [6], solar-thermal energy harvesting [7], and polarization conversion element [8] will be demonstrated.

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