Hollow Two-Dimensional Bimetallic Metal-Organic Framework Hexagonal Nanoplates for Ammonia Sensing

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Abstract:

A lot of interest has been paid to two-dimensional metal-organic framework (2D MOF) nanostructures because of their extreme thinness, high surface-to-volume ratio, and highly exposed active sites. This study describes the production of hollow bimetallic nickel-cobalt benzene tricarboxylic acid (Ni-Co BTC) hexagonal nanoplates without the need of templates or etching, with the aid of polyvinylpyrrolidone (PVP). The adsorbed PVP molecules can provide depletion forces between the nanoplates to prevent their aggregation and limit the vertical growth of MOF layers, which can encourage the production of thin hexagonal nanoplates. In comparison to non-hollow Ni-Co BTC nanoplates, Ni-BTC nanobelts, and Co-BTC microrods, respectively, the hollow Ni-Co BTC hexagonal nanoplates show 1.6, 3.8, and 7.5 times higher sensitivity to NH3. Additionally, they exhibit remarkable stability with just a very slight drop of 2.86% over a period of 6 months and good selectivity to NH3 in the presence of other interfering substances and water. The hollow bimetallic Ni-Co BTC nanoplates improved sensitivity and selectivity are related to the presence of carboxyl and hydroxyl groups, which can encourage hydrogen bonding with NH3 molecules.