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Morphology and Composition Control of Nanostructures in Aqueous Systems

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Abstract

ZnO is a multifunctional semiconductor material that has drawn tremendous research interest in the past few decades. We developed an in situ solution-based doping method was developed to produce Sb-doped p-type ZnO nanowires. This nanostructure showed stable p-type conductivity over 1.5 year. Through similar approach, ZnO nanowires were also doped by n-type carriers. Heavily-doped ZnO nanowires could be a solution to flexible TCO materials. Nanowires often suffer from challenges in being integrated with other functional parts for device fabrication, whereas 2D membrane structures offer great fabrication-friendliness. We developed a surfactant-guided approach to fabricate zinc hydroxyl dodecylsulfate (ZHDS) nanomembranes. The ZHDS nanomembranes were free-standing on water surface and could cover the entire opening area of the reactor. This allows easy transfer of the nanomembranes to arbitrary substrates. It was also found that the ZHDS nanomembranes would undergo a phase transformation process after extended reaction time. The ultimate goal was to prepare ultrathin single crystal ZnO nanosheets. This was achieved by exfoliating ZHDS nanomembranes.