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Synthesis and characterization of zinc oxide (ZnO) nanorods confined in LTA zeolite by post-synthetic hydrothermal encapsulation approach

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Recently, 1D ZnO nanorods have attracted intensive research attention due to their outstanding properties, such as high electron mobility in the growth direction, high surface-to-volume ratio, and good thermal and chemical stability. However, due to the higher presence of active surface atoms, deactivation (dramatic decrease in stability) by secondary nucleation and recrystallization, as well as aggregation during the fabrication process tend to limit their practical applications. Therefore, the stabilization of ZnO nanorods has emerged as a challenging area of research. This study aimed to confine and stabilize ZnO nanorods inside the porous structure of LTA-type zeolites. A modified post-synthetic hydrothermal encapsulation approach was used to synthesize LTA-encapsulated ZnO nanorods where, pre-synthesized LTA zeolites are introduced into the ZnO nanorod synthesis precursor medium, followed by the hydrothermal crystallization. The resulting materials were characterized by scanning electron microscopic (SEM) and powder X-ray diffraction (p-XRD) techniques. The scanning electron micrographs (SEM) revealed the formation of rod-shaped ZnO nanomaterials in the LTA zeolite confinement with much smaller nanorod diameters (~20 ± 5 nm) when compared to those of bare ZnO nanorods synthesized (~200 ± 5 nm). Further, the majority of ZnO nanorods were in a well-separated manner, which implies an increased surface area. Moreover, the p-XRD results confirm the successful synthesis of ZnO nanorods, which are in good agreement with those of the hexagonal symmetry and wurtzite structure. Interestingly, after the ZnO impregnation, the sample still maintains good crystallinity (78%) and the LTA zeolite structure has not been altered. Furthermore, the absence of additional peaks other than LTA zeolite and ZnO nanoparticles in the p-XRD suggests the phase purity of the resulting material. In conclusion, the study suggests the modified hydrothermal confinement approach as a reliable method to synthesize ZnO nanorods confined in LTA zeolites that would have prospective applications.

Keywords: *Confinement, hydrothermal, LTA zeolite, nanorods, ZnO*