Size-tuned graphene quantum dot/magnesium nanocrystal composites for enhanced hydrogen storage performance

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Magnesium (Mg) is one of the most prospective materials for hydrogen storage due to its reversibility and high hydrogen storage capacity. However, the high thermodynamic stability of MgH_2 and sluggish kinetics have been a critical hindrance for its practical use. To resolve such limitations, different strategies have been employed, which includes reducing the particle size and manipulating a composite of Mg with various additives such as carbon materials and transition metals. We synthesized size-tuned graphene quantum dots (GQDs) encapsulated Mg nanocrystals (MgNCs) composites. In this work, the GQDs act as a structure-directing ligand on the surface of Mg; hence, it was expected that a series of GQDs with different size and functional groups can affect the growth of MgNCs, also altering hydrogen storage characteristics of Mg. It exhibits an enhanced hydrogen absorption kinetics for the nanocomposite with the smaller diameter of GQDs. Moreover, MgNCs embedded in an optimized size of GQDs resulted in an outstanding storage capacity. These were attributed to the surface functional group and the steric effects induced by the size-tuned GQDs.