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Nanocomposites for energy storage and catalysis

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As the energy production has not been stable, storage of surplus energy has been getting important. Also, energy materials production such as hydrogen has also been considered an important area for the future energy source. Nanocomposites have been employed to improve the performance of the energy storage devices (supercapacitor), sensors, and photocatalysts. Especially, oxides and sulfides of transition metals have been getting attention as they have good electrochemical performances. However, their performances are not satisfactory. Various materials such as graphene, carbon nano-onions, and carbon nanotubes have been studied to enhance the electrochemical properties owing to their large surface area and high electrical conductivity. Synergistic effects from excellent conductivities of carbonaceous materials and high electrical properties of metal oxides or sulfides have made a huge improvement on the overall electrochemical performances. Doping of graphene with nitrogen or sulfur, using metal sulfides instead of metal oxides, and using highly porous materials as substrates also contribute towards performance improvement.