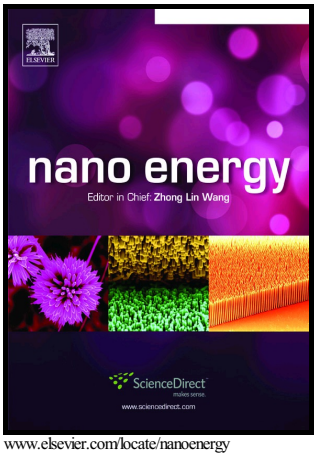

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Particle-in-box nanostructured materials created via spatially confined pyrolysis as high performance bifunctional catalysts for electrochemical overall water splitting

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ABSTRACT: Novel particle-in-box nanostructure was developed and demonstrated as a high performance bifunctional catalyst for electrochemical overall water splitting. The particle-in-box nanostructure was composed of N-doped graphene layer coated Fe-Ni alloy nanoparticles encapsulated within an N-doped carbon hollow nanobox. The nanobox serves as a nanoreactor with the reactant, water, and catalyst nanoparticles confined within for intimate contact and effective reaction. The particle-in-box nanostructure was created through a spatially confined pyrolysis process by taking polydopamine coated $Ni_3[Fe(CN)_6]_2 \cdot H_2O$ nanocubes as the precursor, calcination of which leading to formation of an N-doped porous carbon shell from the carbonization of the polydopamine coating layer and formation of interior N-doped graphene layer coated Fe-Ni alloy nanoparticles from reduction of both iron and nickel ions and graphitization of the CN groups. The particle-in-box nanostructured catalyst exhibited excellent electrocatalytic activities, achieving overpotentials of 270 and 201 mV for the oxygen and hydrogen evolution reactions, respectively at 10 mA/cm^2, and thus is suitable of serving as a high performance

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