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Mechanochemical-assisted synthesis of ternary sulfide embedded in carbon for efficient hydrogen evolution reaction

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Hydrogen energy, with high energy density and clean emission, has attracted significant attention in scientific community due to their potential as a way to reduce reliance on traditional fossil fuels. Hydrogen evolution reaction (HER), a cathodic process in water electrolysis, provides a green and efficient way for sustainable hydrogen generation. In this work, we adopt a facile synergistic coupling strategy to synthesize ternary sulfide RuNiS nanohybrids with an intriguing morphology featuring highly-dispersed RuNiS nanocrystalline embedded in carbon matrix. The key to our success lies in the utilization of mechanochemical-assisted synthesis, which can not only obtain highly-dispersed metal sulfide nanocrystalline, but also facilely tailors the electronic structure with variable active sites. Owing to the well-controlled structure, abundant active sites and synergistic effects between multiple metal sites, the composite exhibits excellent performance for HER in both alkaline and acid electrolytes. To our delight, RuNiS-N/C delivers a small overpotential of 25 mV at the current density of 10 mA cm−2 in 1 M KOH, outperforming the benchmark Pt/C catalyst. Meanwhile, such RuNiS-N/C also shows excellent activity in 0.5 M H2SO4, with a small overpotential of 43 mV at the current density of 10 mA cm−2. Therefore, the mechanochemical-assisted synergistic coupling strategy provides new opportunities for the development of highly efficient HER electrocatalysts.

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