

W₂C nano dot-decorated CNT networks as a highly efficient and stable electro catalyst for hydrogen evolution in acidic and alkaline media† [Check for updates](#)

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Abstract

Although tungsten carbide (W₂C) has long been reported as an excellent platinum-like catalyst, it is still a challenge to synthesize W₂C as an electro catalyst for a highly efficient hydrogen evolution reaction (HER) due to its high onset over potential, inevitable aggregation, and lack of a scalable and controllable synthesis method. Herein, we synthesized W₂C nano dot-decorated CNT networks (W₂C@CNT-S) *via* a facile and scalable spray drying method followed by a carbonization process. It is demonstrated that this unique nano architecture, constructed by ultrafine W₂C nano dots homogeneously decorated on a three-dimensional and conductive CNT skeleton, leads to the exposure of abundant catalytic sites and promotes highly efficient electron transfer and ion diffusion during the HER process. As a result, in acidic and alkaline media, the optimized W₂C@CNT-S hybrid exhibited excellent HER performance with very low onset over potentials of only 60 and 40 mV (*vs.* RHE) and very small Tafel slopes of 57.4 and 56.2 mV dec⁻¹, and only needed 176 and 148 mV (*vs.* RHE) to obtain a current density of 10 mA cm⁻², respectively; it also showed outstanding long-term durability even after a 30-hour test in both acidic and alkaline media. This study presents an overview of a low-cost and scalable spray-drying strategy to synthesize a high-performance carbide-based electro catalyst for hydrogen evolution.