Graphene-dot-Armored Cotton Candy-like Metallic Nanosponge Catalysts for High-Performance Hydrogen Evolution Reaction

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Cotton candy-like metallic nanosponge is suitable as an electrochemical catalyst for effective hydrogen generation because it facilitates the mass transfer of hydrogen gas from the internal structure to the external surface and provides a continuous path for rapid electron transfer, but its large specific surface area is paradoxically capable of accelerating the dissociation of the metallic nanosponge. To protect the metallic nanosponge, we suggest the same concept as the armor made by tiling tiny graphene dots on the surface of the porous structure. It is implemented by one-pot synthesis of graphene dot armored metallic nanosponge, consisting of innovative steps such as intercalating metal ions into carbon dots, exfoliating carbon dots into graphene dots, and growing porous structure guided by attached graphene dots. It not only exhibits excellent long-term stability as expected, but also unexpectedly improves catalytic activity by effectively providing electrons to the strong bonding interface between metal surface and tiny graphene dots. A combined study involving an experimental analysis and density functional theory calculations confirms that the interplay between metal-nanoparticles and graphene-dots not only drives the formation of the unique structure of the graphene-dot-armored metallic nanosponges but also improves both catalytic activity and stability.

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