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Promoting Ultra-High-Density Nanoparticles Exsolution in Layered Perovskite Ferrites via a Facile Cobalt Doping Method: A High-Performance, Stable Anode for Direct Ethane Solid Oxide Fuel Cells

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Nanoparticles anchored on the perovskite surface have gained considerable attention for their wide-ranging applications in heterogeneous catalysis and energy conversion due to their robust and integrated structural configuration. Herein, we employ controlled Co doping to effectively enhance the nanoparticle exsolution process in layered perovskite ferrites materials. CoFe alloy nanoparticles with ultra-high-density are exsolved on the (PrBa)0.95(Fe0.8Co0.1Nb0.1)2O5+δ (PBFCN0.1) surface under reducing atmosphere, providing significant amounts of reaction sites and good durability for hydrocarbon catalysis. The morphology evolution measurements reveal a significant transform in CoFe alloy nanoparticles at around 600 ℃, transforming from larger to ultra-densely decorated smaller nanoparticles. A single cell with PBFCN0.1 anode exhibits high performance in wet ethane atmosphere (e.g., a typical peak power density of 455 mW cm−2 at 800 ℃), which is significantly improved by 36%-70% compared to the sample without Co doping. This discovery emphasizes how temperature influences alloy nanoparticles exsolution within doped layered perovskite ferrites materials, paving the way for more targeted material-specific research and broadening the spectrum of practical applications.

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