

Carbon-Doped Perovskite Ceramic Catalyst for Stable Hydrogen Evolution

Technology Domain: Hydrogen Generation

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Status (Patent/TRL): Patent Pending / TRL 3

Technology Summary:

This invention presents a groundbreaking, highly stable, and corrosion-free ceramic catalyst for the hydrogen evolution reaction (HER), addressing critical limitations of existing metal-based catalysts in terms of activity, cost, and durability in harsh electrochemical environments. The lead-free, perovskite ABC_3 type catalyst, specifically a carbon-doped barium zirconium titanium oxide, is precisely composed (0.2 Ba, 0.001 C, 0.6 O, 0.004 Zr, 0.196 Ti) and synthesized via an energy-efficient 2.45 GHz microwave sintering method, which drastically reduces processing time and energy consumption while ensuring homogeneous grain growth. The catalyst's unique d^0 hybridization and inherent ferroelectric/piezoelectric properties enable electric dipole switching, enhancing charge transfer and reducing energy barriers for HER, as demonstrated by its high stability over 5000 cyclic voltametric cycles in both acidic and alkaline media and favorable Volmer-Heyrovsky kinetics.

This innovation offers a scalable, cost-effective, and environmentally friendly solution for efficient hydrogen production, with significant implications for renewable energy and industrial applications.

