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Department: Physics

Project Title: **Hafnium Loaded Proton Conducting Oxide for Direct - Hydrocarbon Intermediate Temperature Solid Oxide Fuel Cell Application.**

Funding Agency: **Anusandhan National Research Foundation (ANRF)**

Sanction Amount: 45,37,192 (in Rs.)

Sanction Letter: CRG/2023/008073 Dated 01.05.2024

Tenure: 3 Years

Abstract:

The objective of the research proposal is to develop robust direct- hydrocarbon intermediate temperature (400-700°C) fuel cell using proton conducting oxides as a compatible and potential power source which eradicates the fuel processor units. Further coupling into the current power grid will upgrade their energy conversion efficiency and subsidize toxic effluents. Conventional direct- hydrocarbon solid oxide fuel cell (SOFC) with high functional temperature (800 -1000 ℃) uses Ni-YSZ as the anode due to their high catalytic and electrophysical response. However, material degradation via coking and Sulphur poisoning of the acidic YSZ surface forbids coke migration against carbonaceous fuels. This leads to poor long-term durability of the system, and the high operating temperature impose shortcomings upon the compositional stability and cell performance. To overcome this limitation, investigators have planned to fabricate Ni- modified hafnium based rare earth doped barium cerate proton conducting oxide, as robust anode which will accelerates C—OH formation due to a basic anodic surface with adequate H2O intake. This as a consequence improves the coking tolerance at intermediate temperatures resulting longer durability of the fuel cell. Hafnium based rare earth doped barium cerate will be used as electrolyte which have a lot of potential in term of chemical inertness, high protonation, hydration thermodynamics and low electron transfer numbers at intermediate temperatures (400 – 650 ℃). Meanwhile, Cobalt free, complex oxide based on doped barium ferrite as cathode materials which considered to improve the transport property, oxygen reduction kinetics as well as chemical stability of the cathode. All ceramics synthesis will be carried out via solid state reaction route. The detailed structural, chemical, thermal and electrical properties of the materials shall be carried out to understand their temperature dependent response under different hydrocarbons (methane, ethane and propane). The cell performance is expected to achieve excellent power density and long-term durability (more than 1000 hours), opening a new pathway for the advent of durable direct-hydrocarbon intermediate temperature SOFC.