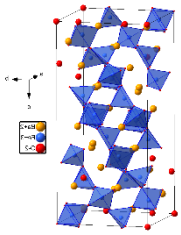
Master Thesis (2 positions):

Synthesis of novel mixed ionic and electronic conducting materials (MIEC) and investigation of their electrochemical properties

Project description

Solid oxide fuel cells (SOFC), which are widely considered as efficient energy conversion devices, have the capability to shape the future of green energy development. However, commercialization of SOFC is obstructed by various challenges such as long-term instability of cathode at high-temperature and sluggish kinetics of oxygen reduction reaction (ORR). So, today's research in the direction of solid oxide fuel cells emphasized the synthesis of low temperature and intermediate ABO_3-type MIEC cathode materials.

In this regard, $BaFeO_{3-\delta}$ have gained substantial importance due to its mixed ionic and electronic conducting nature, possibility of doping or substitution at A, B-sites, incorporation of vacancies on O-site with water or more electronegative element as compared to oxygen which make it a suitable candidate as cathode for proton-conducting solid oxide fuel cell (H-SOFC) and oxygen-conducting solid oxide fuel cell (O-SOFC).



This project is mainly focused on hydration and topochemical fluorination of A-site and B-site doped $BaFeO_{3-\delta}$ which will be achieved by nebulized spray pyrolysis (NSP) and solid state reaction (SSR) respectively.

Research Goals

- Synthesis of hydrated and fluorinated phases of $BaFeO_{3-\delta}$ via NSP and SSR.
- Optimization of synthesis approach to achieve high-purity of both the hydrated and fluorinated phases.
- Investigation of structure, morphology, and the electrochemical properties of synthesized compounds.

Techniques and methods

- X-ray diffraction (XRD), electrochemical impedance spectroscopy (EIS), Scanning electron microscopy (SEM) and iodometric titration
- Thermogravimetric analysis (TGA) for hydrated compounds, Fluoride ion selective electrode for fluorinated compounds

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