LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coach	Supervisor(s)	Funding
<Dr Prabhuraj Balakrishnan>	<Prof Kevin M. Van Geem>	-

Title - Analysis of impact of phase change behaviour/oxygen functionalities of perovskites on oxide ion conductivity (for use in solid oxide electrolysers)

Aim

An experimental study of phase change behaviour of perovskite materials in relation to ionic conductivity at various environments is proposed in this study. This study tackles primary challenge in understanding the importance of oxygen functionalities on their prominent property - ionic conductivity which plays a main role in performance of electrolysers.

Justification

Solid oxide electrolysers, remains in a prominent position in hydrogen value chain due to its high efficiency, among other hydrogen production methods. Presently the hydrogen production is rated at 500 to 1500 mL h^{-1} cm^{-2}. This effectiveness depends on the oxide ion conductivity of the material used in the membrane region of these electrolysers. Lanthanum based perovskite (($LaGaO_3$) and zirconium oxides (ZrO2), are manly used because of their high conductivity. Upon exposure to high temperatures at different environments - nitrogen, oxygen and hydrogen atmospheres, these materials undergoes transition in their lattice parameters and oxygen valency, wherein the ionic conductivity depends on these factors.

Therefore study of phase change behaviour of oxide materials for ionic conductivity is proposed in this study. All of these activities will be carried out at laboratory for Chemical technology (LCT) campus in Ghent University (where electrolyser set up will become fully operational around Sep 2024), Ghent where materials, equipment and elemental characterization facilities are already available.

Program

1. Processing of perovskite materials (solvo-thermal treatment and drying).

2. Treatment of the synthesized materials to sintering at various temperature / atmosphere (nitrogen / hydrogen / oxygen) conditions.

3. Analysis of materials using characterization techniques - Identification of phase change using - x-ray diffraction technique, elemental composition using - scanning electron microscopy, oxygen functionalities using - x-ray photo electron spectroscopy (XPS) and calculation of lattice parameters from the above characterization results.

4. Measurement of through-plane and in-plane ionic conductivity (from the slope of current - voltage curve and impedance spectroscopy analysis) of the samples.

5. Relating elemental characterization analysis results to ionic conductivity and presentation in the form of Msc thesis and conference paper.