LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coach	Supervisor(s)	Funding
<Dr Prabhuraj Balakrishnan>	<Prof Kevin M. Van Geem>	ENERGY TRANSITION FUND - MOLECULES AT SEA

Title - Analysis of impact of electrolyser operating conditions on oxide ion conductivity of yttrium membranes (solid oxide steam electrolysis)

Aim

An experimental study of electrolyser operating conditions in relation to ionic conductivity of yttrium based membranes at various environments is proposed in this study. This study aims to understand the importance of oxide ion conductivity of yttrium membranes and final electrolyser performance - power efficiency and faradaic efficiency.

Justification

High temperature steam electrolysers, occupy a prominent position in hydrogen value chain due to its high efficiency, among other hydrogen production methods. Presently their production is estimated at 50 to 200 mL h^{-1} per unit area. This effectiveness depends on the oxide ion conductivity of the material used in the membrane region of these electrolysers. Yttrium oxide (Y_2O_3), is mainly used because of their high conductivity. Upon exposure to steam electrolyser conditions - steam, oxygen and hydrogen atmospheres, these materials undergoes transition affecting the oxide ion conductivity.

Therefore study of yttrium oxide materials and their role in various electrolyser operating conditions 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 yttrium oxide powder materials (wet chemical treatment).

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 ionic conductivity and reporting their performance in electrolyser conditions in terms of power efficiency/faradaic efficiency.

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

LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

GHENT UNIVERSITY

DRIVING CHEMICAL TECHNOLOGY