National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Studies on Modelling for Diffusion-Mass Transfer in Solid Oxide Fuel Cell
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Venue	: Meeting Hall, Department of Chemical Engineering (Hybrid Mode)
Date and Time	: 06 Mar 2024 (03.30PM)
Abstract	: The diffusion-mass transfer in Solid Oxide Fuel Cell (SOFC) is a complex phenomenon. A lot of experimental work and modeling work have been conducted over the years to understand and design efficient electrodes in SOFC to facilitate faster diffusion. An accurate model can help in predicting the best physical properties required for the construction of an efficient electrode in a short time. A comparative mathematical analysis on different models available in literature was conducted to assess their viability and accuracy under operating conditions of SOFC. The physical parameters such as porosity and tortuosity factor were used as fitting parameters to validate the modelling results with the experimental data. A binary fuel system with H_2- H_2O and a ternary fuel system with H_2-H_2O-Ar were used to validate the modelling results. The study concludes the pressure gradient to be an important factor when the pore radius value goes below 0.8 μm and current density goes above 0.5 A/cm^2. The modified Binary Friction model (MBFM) produced the best match to the experimental data under most of the conditions considered in the study. The Dusty Gas modified Friction model (DGMFM) was found to be a good approximation to the Dusty Gas model (DGM) for binary system. Considering advantages of the MBFM and to suit the needs of commercial CFD software, it is desirable to uncouple the mass transport flux equations and re-formulate the MBFM. Thus, the MBFM is rearranged and a model with uncoupled expressions for mass flux is formulated with reasonable assumptions. The new model is tested for Solid Oxide Fuel Cell (SOFC) cermet anode running on two, three and multi component, fuel systems using electrochemical modelling. It&rsquos predicting capability is compared with pre-existing conventional models such as the DGM and MBFM for a wide range of structural and operating parameters. The results obtained suggest that the new model is capable of predicting in the similar manner to the MBFM for 96% of the parametric conditions applied in the study.
	Keywords: Solid Oxide Fuel Cell, Knudsen diffusion, Diffusion overpotential, Pressure gradient