UNIVERSITÄT DUISBURG ESSEN

IVG Institut für Verbrennung und Gasdynamik
Fakultät für Ingenieurwissenschaften

ZBT In cooperation with the ZBT GmbH

Master's project:

Influence of dispersion process and formulation composition on physico-chemical properties of electrocatalyst inks

Background:

Proton exchange membrane fuel cells (PEMFCs) are promising clean and sustainable energy sources for mobile, stationary and portable applications. Although PEMFCs have reached a pre-commercial stage, their large-scale production is hindered. This is attributed to an elusive and empirically optimized catalyst ink formulation that results in poor utilization of materials and thereby increasing the production costs. During ink formulation (see Fig. 1), Pt particles supported on carbon (an active material) are dispersed in a colloidal suspension containing ionomer (a polymeric binder) and usually a mixture of solvents (a continuous phase) that govern physico-chemical properties such as aggregation, rheology, surface tension, and stability. Thus, there is a growing need for understanding the complex nanoscale interactions within the ink constituents and the interplay between these interactions and dispersion processes that may open an avenue for scalable manufacturing of fuel cells. In this project the effects of dispersion method, solvent composition, and ionomer content on particle size, stability, rheological behavior and electrochemical performance will be systematically studied by means of analytical centrifugation (AC) (see Fig 2), dynamic light scattering, scanning electron microscope, viscometer and rotating disc electrode (RDE) technique. By establishing these process-structure-property relationships, an economical and knowledge-based ink recipe will be developed for optimized fuel cell electrodes.

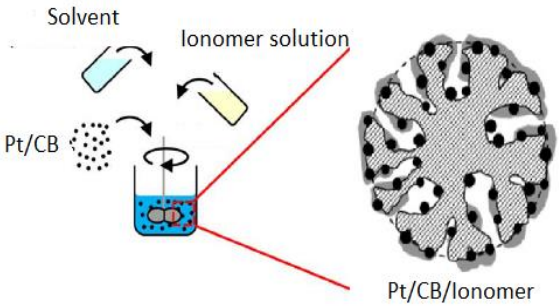

Fig. 1: Schematic of Ink formulation


Fig 2: Analytical centrifuge

Task description:

a) Investigate the effects of different dispersion techniques (ultrasonic bath, sonotrode) on particle size, dispersion stability.
b) Examine colloidal behavior – aggregation, rheology at different isopropanol-water composition.
c) Study the influence of ionomer content on the structure and rheology of ink.

Requirements:

Studies in engineering sciences, materials science, or chemistry; interest / basic knowledge in colloid science and characterization of inorganic materials is beneficial. Electrocatalytic knowledge desirable Safe work practices, ability to take initiative and good interpersonal are expected.

Start: Immediately **Duration:** 6 months

Contact Person:

M.Sc. Shalmali Bapat
ZBT, Room 240
Tel. (0203) 379 – 3100
shalmali.bapat@uni-due.de

M.Sc. Fatih Özcan
ZBT, Room 240
Tel. (0203) 379 – 3100
fatih.oezcan@uni-due.de

Dr. Sebastian Kohsakowski
ZBT, Room 2404
Tel. (0203) 379 – 3126
S.Kohsakowski@zbt.de