Bubble Release from Tunable Porous Carbons

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Fuel cells and electrolyzers are considered a promising alterantive for energy storage. Through a redox reation occuring on an anode and a cathode, we can extract an electric current to extract energy. However, fuel cells are not yet commercial due to many obstacles. Catalysts alrentatives and low power density isuues are usually discussed, but another major problem of FC (or electrolyzer) is bubble poisining, which occurs when gas is generated through an electrochemical reaction, leading to bubble formation and adhesion to the electrode. This continues adhesion lowers the surface area, decreases mass transfer, reduces exposure of active material.

One of the methods to tackle bubble poisining is by porous structures. Different types of porous strucures can help with mitigating bubbles, each with its own unique pore size distribuation, surface area, tortuosity etc. Nevertheless, cracking the link between porous structure and bubble mitigation is not simple, as many variables come to play at the bubble release and dynamics.

In order to understand better the relationship between mitigating bubbles and pore size, we synthesized 4 different materials with spherical pores, through hard template method, using acrylonitrile as a precursor and silica spheres as template, changing only the pore size (40, 80, 120, 200 nm). Decoupling pore size from the porous structure parameters, we can understand the relation between bubble release and pore size.

The materials were characterized with scanning electron microscopy, N_2 adsorption, and Raman spectroscopy. Hydrazine oxidation and hydrogen evolution were used for electrochemical making of bubbles, using voltammetry and amperometry methods, measuring different parameters to study this link. Different setups of 3 electrode cell was also used to study the bubble formation and adhesion using photography, showing a trend as pore size increases.