

Adsorption.. for *Beyond* Adsorption

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Recently porous carbon has been used for various processes where its pores play a significant role but... a high amount adsorbed is not a final target. This includes its application as an oxygen reduction or CO₂ reduction electrocatalyst. Our recent research focuses on application of nanoporous metal free carbons as catalysts for these processes. Although other heteroatom doped nanoforms of carbons have been studied in these processes, we focus on the unique combined role of porosity and surface chemistry, which might enhance the reduction efficiency via enhanced adsorption. Both processes take place in aqueous environment and under applied bias potential. The reduction processes take place on the catalytic sites related to the presence of heteroatoms on the carbon surface.

We hypothesize that the efficiencies of these catalytic processes are affected by the strength of the target species adsorption in the pore system. That adsorption must happen a priori the reduction process. In both cases gases (O₂ or CO₂) are dissolved in the electrolyte and their reduction occurs on the carbon surface. In the case of ORR the role of porosity might be in strong withdrawal of oxygen from electrolyte to hydrophobic pores similar to their sizes where the electron transfer might take place. In the case of CO₂, on the other hand, via electron transfer the intermediate CO₂⁻ is formed and then upon its adsorption and reduction- CO appears as the reduction products. Then to form methane, C-O bond must split and protonation must take place. Therefore, it is plausible to assume that in small pores of carbons where CO and hydrogen (from water splitting) are strongly adsorbed methane can be formed as in Fisher-Tropsch process, owing to the specific conditions existing there (high pressure and strong adsorption).

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