

CO₂ INTERACTIONS WITH POROUS CARBONS: IS THE SURFACE STABLE AT AMBIENT CONDITIONS?

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Interactions of CO₂ with polymer derived carbon/rGO composites at ambient conditions were studied. Both, dynamic adsorption tests and equilibrium adsorption measurements were analyzed. The samples differed in the porosity, oxidation level and speciation of sulfur on the surface. Even though more CO₂ was adsorbed on the oxidized sample than in the unmodified one, the surface chemistry of the latter was found as having more pronounced effect on attracting CO₂ to the pore system.

The results showed the marked changes in S-doped nanoporous carbon composite surface chemistry upon CO₂ adsorption at ambient conditions. The changes were more pronounced for carbon with higher density of sulfur in thiophenic configurations on the surface emphasizing the role of these species in CO₂ reduction. Even though CO could not be the target of our detection, identification of water, SO and SO₂ as products of surface reactions supports our hypothesis that CO₂ adsorption was accompanied by some extent of its reduction to CO. CO is formed in the process of electron transfer from thiophenes to CO₂ in which the former are oxidized forming sulfones and sulfonic acids. Those species are likely thermodynamically unstable and decompose forming SO/SO₂ and water providing additional electrons for CO₂ reduction. Conductivity of carbon matrix and the local increase in this feature owing to the presence of the graphene-based phase facilitate this process.

Based on the results collected, it is recommended that the stability of carbons towards carbon dioxide should be evaluated before it is used as CO₂ sequestration medium.