CO_2 interactions with porous carbons: is the surface stable at ambient conditions?

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Interactions of CO_2 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 CO_2 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 CO_2 to the pore system. The results showed the marked changes in S-doped nanoporous carbon composite surface chemistry upon CO_2 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 CO_2 reduction. Even though CO could not be the target of our detection, identification of water, SO and SO_2 as products of surface reactions supports our hypothesis that CO_2 adsorption was accompanied by some extent of its reduction to CO. CO is formed in the process of electron transfer from thiophenes to CO_2 in which the former are oxidized forming sulfones and sulfonic acids. Those species are likely thermodynamically unstable and decompose forming SO/SO_2 and water providing additional electrons for CO_2 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 CO_2 sequestration medium.

References

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