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CO_2 capture using alkaline metal oxide-mesoporous carbon synthesised from biomass by a solvent-free method

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The rapidly-increasing concentration of atmospheric carbon dioxide (CO_2) has emerged as a critical environmental concern, since greenhouse gases are largely responsible for decreasing air quality and global warming.[1] In this scenario, CO_2 capture has become an technological solution for reducing CO_2 emissions and its effects on the environment.[2] Therefore, the incorporation of basic active sites into ordered mesoporous carbons (OMCs) have drown more attention, due to the fact that OMCs presents high surface areas, pore size of 2-5 nm and large pore volumes, moreover the surface basicity improves their capacity of acidic gas capture.[3] The process can be more environment-friendly when the OMC is produced by biomass and *via* a sustainable route (solvent-free). This project aims to asses the CO_2 capture capacity of OMC doped with Calcium. Firstly, the material was produced using the solvent-free method.[3] A mixture of 100 g in total of Tannin, F127, and Terephthalaldehyde in a 1:1:0.5 proportion, respectively, was prepared. Additionally, approximately 7.5 g of calcium acetate monohydrate was added to the mixture and the precursors were ground in a planetary mill (PM100 Retsch) for 15 minutes. After the grinding, the mixture was heated under inert atmosphere in a tubular fixed-bed oven (MTI-OTF-1200X) up to 800 °C. After the carbonization, the material was designated by OMC-Ca. For CO_2 capture test, nearly 5 mg of OMC-Ca were placed in alumnum boat of a thermo-gravimetric analyzer DTG-60H (Shimadzu) under N_2 atmosphere for 1h30min for purging. Then, OMC-Ca was heated until 150 °C for 30 minutes for cleaning. Subsequently, the material was cooled to 25 °C and the gas was switched to CO_2 (flow rate of 50 mL/min), maintaining this condition for 2h to saturate the atmosphere. The results of physisorption gas analysis show that OMC-Ca presents a type IV isotherm, average pore size 4,9 nm, specific surface area BET (Brunauer, Emmett, Teller) 464.260 m^2g^{-1}, total pore volume 0.415 cm^3g^{-1}. Besides, OMC-Ca was determined by thermo-gravimetric analysis under an air atmosphere, suggesting that around 27% of Calcium oxide was introduced into the mesoporous carbon. The preliminary study of CO_2 capture showed that, in 120 minutes, OMC-Ca's mass increased approximately 7% and the curve had not reached the plateau, wich means that OMC-Ca will continue to capture CO_2 as time increases. Nonetheless, it was possible to capture CO_2 using a mesoporous carbon Calcium-doped produced by a sustainable route and the results are promising. In the future, CO_2 capture in physisorption analysis equipment will be tested.

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References

[1] F. C. Özbugday, Energy, **82**, 734 (2015).
[2] U. Kamran, Journal of Cleaner Production, **290**, 125776 (2021).
[3] W. Shan, Journal of Materials Chemistry A, **5**, 23445 (2017)