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Toward sustainable hydrogen storage and carbon dioxide capture in post-combustion conditions

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Abstract

This work addresses two environmental issues of major concern: hydrogen storage for hydrogen economy implementation and CO₂ capture to reduce greenhouse gas emissions. For these purposes, two granular activated carbons were synthesized through chemical activation of olive stones by means of potassium salts (KOH and K₂CO₃). The porosity characterizations reveal typical ultramicroporous carbons with average pore sizes of about 0.53 and 0.69 nm for K₂CO₃ and KOH-activated carbons, respectively. The volumetric measurements of cryogenic hydrogen adsorption show monolayer process. At sub-atmospheric pressures the narrower micropores show stronger binding energy to hydrogen molecules. However, at higher pressures this porosity range saturates and KOH-activated carbon exhibits a H₂ storage capacity of 3wt%, 70% of which is achievable at only 1 bar. CO₂ shows a similar behavior than H₂ when it was adsorbed purely at 0°C, and AC_KOH retains its excellence with a capacity of 5.6 mmol g⁻¹ at 1 bar. Finally, the two carbons were tested as CO₂ adsorbents in conditions representative of post combustion capture applications (10% CO₂ at atmospheric pressure and at 50°C). Both carbons show fast adsorption-desorption kinetics,

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