Carbon Dioxide Storage in Mesoporous Materials

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MVC Sasthri Hall, 9 am, 26/08/2017

Abstract

The everlasting problem of increase in the concentration of carbon dioxide in the atmosphere created a significant boom in the field of scientific research related to the capture, conversion and utilisation of carbon dioxide, and thereby utilise CO_2 for the betterment of humanity.

Mesoporous materials as a solid sorbent material for carbon capture applications is advantageous because of their inherent properties such as **high surface area, porosity, and tunable surface functionalities**. Several porous materials, such as activated carbons, porous carbons, zeolites, mesoporous silica, and metal–organic frameworks, have been investigated as potential solid adsorbents for CO_2. However, each of these materials has their advantages and disadvantages. For example, zeolites offer large surface areas and have specific sites suitable for adsorption, but the small pore system poses diffusional problems. On the other hand, metal–organic frameworks suffer from low physicochemical stability, although they exhibit a high specific surface area.

Porous carbon materials appear to be an ideal adsorbent for CO_2 because of their **high surface area, low cost, easy regeneration, high chemical and thermal stability, tunable porosity, and easy to control morphology**. However, the adsorption capacity of carbon materials is low owing to weaker adsorbent–adsorbate interactions that are ascribed to the hydrophobic nature and lack of surface charges. It has been suggested in some reports that the incorporation of core functionalities, such as nitrogen or free @NH or @NH_2 groups could enhance the CO_2 adsorption capacity of carbon-based adsorbents because nitrogen atoms can interact through their lone pairs with the mildly acidic CO_2 molecule. It has been reported that the **incorporation of nitrogen atoms into the carbon matrix** is a complex process because either post-treatment normally achieves it with ammonia at high temperature or organic functionalization of carbon materials with a suitable amine.

However, these methods of incorporating nitrogen atoms into the carbon matrix are expensive and time-consuming, and the control over the core functions introduced seems to be very difficult.

This presentation is mainly about an upcoming material that satisfies all necessary prerequisite for the surface adsorption of carbon dioxide.

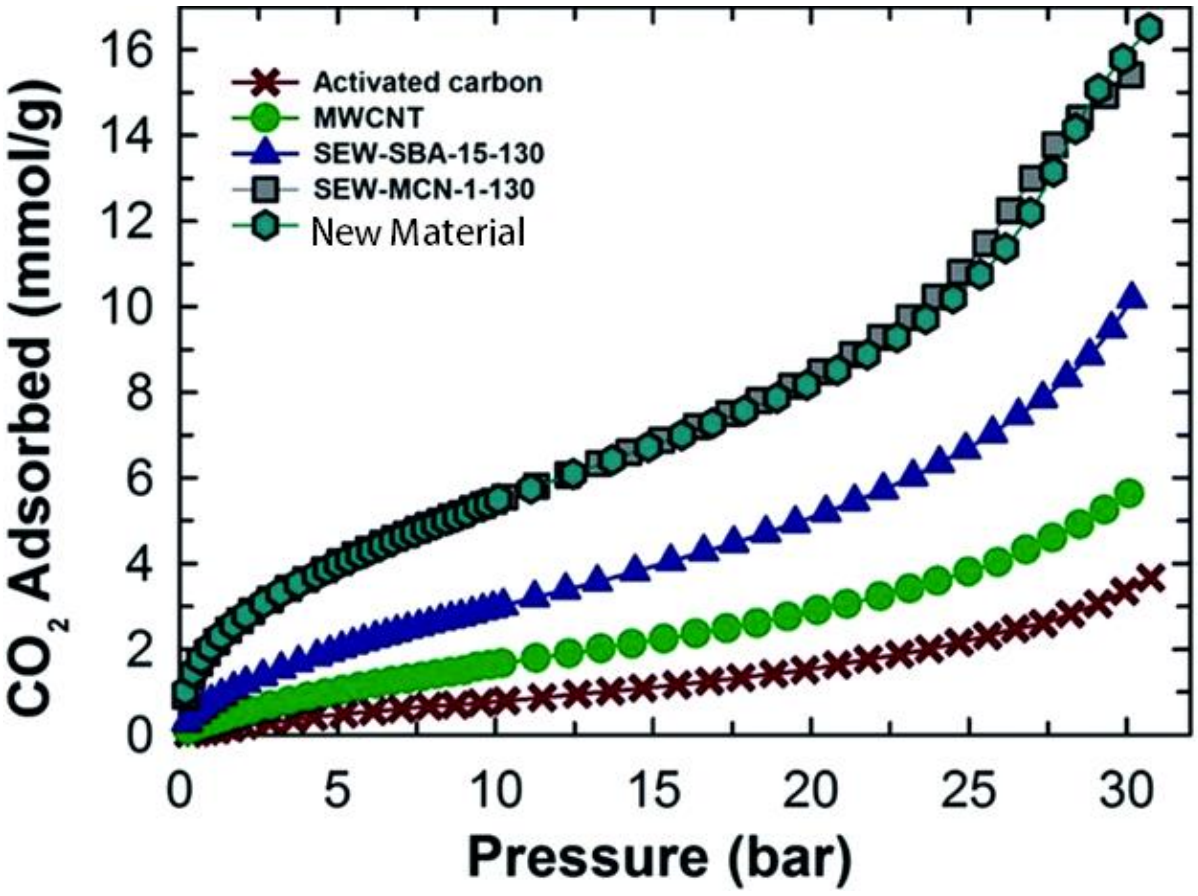

Figure: Comparison of the CO_2 adsorption capacity of different materials.