Developing SO_2-Tolerant Amine-Based CO_2 Adsorbent

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Amine-containing solids are promising adsorbents for post-combustion CO_2 capture, but they suffer from irreversible poisoning by strongly acidic SO_2 in a flue gas. In the present work, we demonstrated a strategy to suppress the SO_2 poisoning of amine-based adsorbents by introducing a protection layer at the outer surface of adsorbents. We first prepared an amine-based adsorbent by impregnating polyethyleneimine (PEI) into a porous silica support. Then, PEI located at outer rim of the adsorbents were selectively alkylated with epoxide so that the amines were fully converted to tertiary amines. Different from primary and secondary amines, SO_2 adsorption on tertiary amine is weak and reversible. Therefore, during the adsorption in a flue gas, SO_2 is reversibly captured by this outer tertiary amine-rich layer, while CO_2 is adsorbed on the primary and secondary amines at the core of adsorbent. The resultant core-shell adsorbent showed insignificant loss of CO_2 adsorption capacity (8.52%) even after 1000 CO_2 adsorption-desorption cycles in the presence of 50 ppm SO_2, while a conventional PEI/silica showed a severe capacity loss (65.1%) due to irreversible SO_2 poisoning.