Important Design Factors of Amine-Based Solid Adsorbents for Post-Combustion CO_2 Capture

최우성, 최민기†
KAIST
(mkchoi@kaist.ac.kr†)

Substantial efforts have been made to increase the CO_2 working capacity of amine adsorbents for efficient CO_2 capture. However, the ultimate metric for assessing adsorbents is not the CO_2 capacity but the regeneration heat required for capturing a fixed amount of CO_2. In this work, we synthesized PEI/SiO2 adsorbents functionalized with various epoxides. This provided adsorbents with different amine structures showing various CO_2/H_2O adsorption properties. Our studies revealed that, contrary to what we would normally expect, the CO_2 working capacity was not a decisive factor in determining the regeneration heat required for CO_2 capture. This is because the benefit of large CO_2 working capacity was cancelled out by the difficulty of CO_2 desorption. Instead, the suppression of H_2O co-adsorption was critical for reducing regeneration heat, because substantial latent heat is required for H_2O desorption. Consequently, the PEI/SiO_2 functionalized with 1,2-epoxybutane required much lower regeneration heat (2.66 GJ tCO_2^{-1}) than the conventional PEI/SiO_2 (4.03 GJ tCO_2^{-1}), because of suppressed H_2O co-adsorption as well as moderately high CO_2 working capacity.