Synthesis and Evaluation of Diamino Organosilane-Functionalized Silica Adsorbent for CO_2 Capture

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Global warming is primarily due to the increased amount of greenhouse gases emitted into the atmosphere. Among the greenhouse gases, carbon dioxide is the greatest contributor; consequently, efforts have been dedicated to mitigating anthropogenic CO_2 [1]. Carbon Dioxide Capture and Sequestration (CCS), a set of end-of- pipe technologies and processes that allow continuous utilization of fossil fuel sources while significantly reducing carbon dioxide emissions, has been receiving widespread attention [2]. The conventional capture technique is via absorption; however, the interest has shifted towards adsorption for it provides several advantages over the former [3].

The organic-inorganic hybrid adsorbents, such as amine-functionalized silica, have emerged as advantaged candidate materials for post-combustion CO_2 capture due to their high CO_2 capacity and selectivity [4]. Nonetheless, the evaluation of adsorbents for CO_2 capture includes not just assessment of its CO_2 adsorption capacity but also its regenerability (adsorption/desorption cycle). Unfortunately, these adsorbents require a relatively high temperature for desorption, where significant deactivation of amines via urea formation takes place [5] (see fig. 1).

In this work, the overall performance of amine-functionalized silica sorbents prepared by chemical incorporation of linear diamino organosilanes was evaluated. The characterization and assessment were completed by TGA and FT-IR.

The diamino organosilanes used were illustrated in fig. 2. It can be seen from the figure that these types of amines have a comparable number of nitrogen atoms, which are farther away from each other (separated by three to four carbon atoms) as compared with typical aminosilanes (fig. 1) employed in other studies. From that difference, it could be inferred that these diamino organosilanes are more resistant to urea formation; consequently, to degradation.

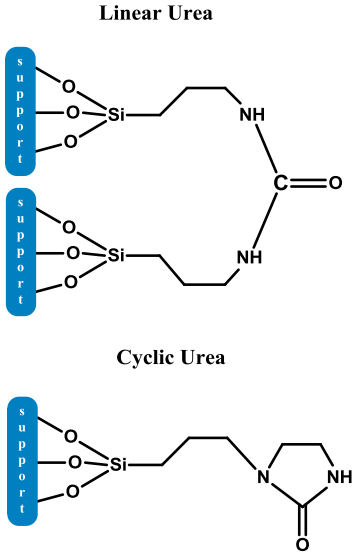

Fig.1 Common degradation products of supported amine sorbents.

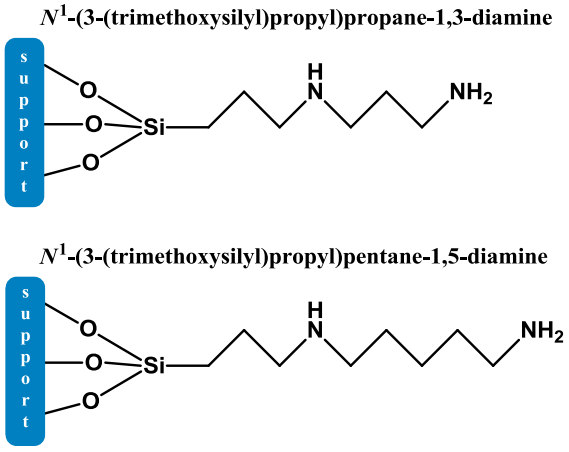

Fig. 2 Structure of the diamino organosilanes.

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