The Different Regimes of Carbon Capture: Challenges and Opportunities

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Carbon dioxide is produced by a variety of stationary sources including agricultural processing, refineries, electricity production, and mining. It is a well-known greenhouse gas and major contributor to global warming and climate change. Fossil fuel emissions alone account for over 90% of total CO_2 emissions from human sources. In 2014, emissions reached a staggering 9 gigatonnes of carbon per year. The effective capture of CO_2 from these various process streams is an important strategy to mitigate CO_2 emissions in concert with the development of alternative energy sources. The use of solid adsorbents for CO_2 removal has been a major focus in recent years. However, no single material or class of material has emerged as a leading candidate for effective capture of CO_2. An effective adsorbent must have high capacity and high selectivity for CO_2 at the concentration and working temperature of the process. These requirements are complicated by the fact that CO_2 conditions vary widely depending on the point source. Four major focus areas for CO_2 removal include post-combustion capture, pre-combustion capture, oxyfuel combustion capture, and direct air capture. The CO_2 concentrations vary across these four technologies from as low as 400 ppm to as high as 90% by volume. This presentation will discuss the challenges, progress, and opportunities for using adsorbents to capture CO_2 from these different concentration regimes.