The Different Regimes of Carbon Capture: Challenges and Opportunities

Krista S. Walton, Professor and Marvin R. McClatchey and Ruth McClatchey Cline Faculty Fellow
School of Chemical & Biomolecular Engineering, Georgia Institute of Technology

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 CO₂ emissions from human sources. In 2014, emissions reached a staggering 9 gigatonnes of carbon per year. The effective capture of CO₂ from these various process streams is an important strategy to mitigate CO₂ emissions in concert with the development of alternative energy sources. The use of solid adsorbents for CO₂ 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 CO₂. An effective adsorbent must have high capacity and high selectivity for CO₂ at the concentration and working temperature of the process. These requirements are complicated by the fact that CO₂ conditions vary widely depending on the point source. Four major focus areas for CO₂ removal include post-combustion capture, pre-combustion capture, oxyfuel combustion capture, and direct air capture. The CO₂ 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 CO₂ from these different concentration regimes.