A NATURE-INSPIRED PASSIVE AIRFLOW SYSTEM FOR CARBON CAPTURE AND SEQUESTRATION

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Increasing levels of carbon dioxide (CO_2) emissions continue to threaten communities and biodiversity worldwide. Carbon capture and sequestration (CCS), where CO_2 is removed from the air and stored so it cannot return to the atmosphere, has the potential to reduce these impacts. However, CCS systems are unpopular due to their high energetic and financial costs [1]. To-date, few systems exist that can effectively remove CO_2 from ambient air and the majority are designed solely to remove CO_2 from flue gas produced by power plants. Although half of global emissions can be captured from flue gas, the other half, produced by sources such as transportation, can only be removed from ambient air through direct air capture (DAC) [2]. To address the issue of high energetic cost, and provide another option for ambient air CCS, a passive airflow system was developed. This system replaces the energetic input used to bring CO_2 into DAC systems from devices such as electric fans. Passive airflow is enabled with a design inspired by prairie dog burrows where a mound-shaped pipe connector forces air to move upwards through a column, due to wind flowing over it. Optimal capture of CO_2 is facilitated by the interaction of air flowing upwards, countercurrently with a chemical solution flowing downwards. This solution contains carbonic anhydrase enzymes which facilitate the conversion of CO_2 into carbonate ions which combine with magnesium ions in solution to form solid magnesium carbonate. This crystal precipitates out of solution, sequestering the CO_2 in a solid form. Scaled up, the current prototype could have a comparably low energy cost to other CCS technologies. However, passive airflow can be adapted for other carbon capture methods lowering the energy cost of CO_2 removal from air and potentially resulting in a lower financial cost making CCS a more attractive option for reducing the effects of climate change.

References:

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