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Electrospun Poly(Vinyl Alcohol) – L-Arginine Nanofiber Composites for Direct Air Capture of CO2

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Background

The accumulation of carbon dioxide (CO2) in the atmosphere has been documented to be the primary driver of global warming. The global average CO2 levels in the atmosphere continue to rise, with a predicted 1.5°C increase in global temperatures within the next two decades. The capture and storage of CO2 is an essential part of mitigating climate change. Point source CO2 capture alone from emission sources like power plants, refineries, and factories is no longer sufficient since it does not address CO2 emissions from dispersed sources including the transportation or housing sectors. Non-point sources account for ~50% of global CO2 emissions, so technologies that capture CO2 from ambient air are needed to achieve net-zero emissions globally by 2050.

Direct air capture (DAC) is the only current technological solution capable of achieving negative carbon emission. DAC can complement point-source CO2 capture and storage (CCS), compensate for residual emissions that escape during point-source capture, and target distributed emissions. Traditionally, liquid sorbents like aqueous solutions containing potassium or sodium carbonate/hydroxide or alkanolamine solvents like monoethanolamide (MEA) or diethanolamine (DEA) have been used to capture CO2. Amino acids have the same functional groups as alkanolamines and are potentially environmentally friendly. Amino acid solutions also have higher surface tension, lower volatility, better chemical and thermal stability, and exhibit similar or better CO2 absorption compared to alkanolamines. L-arginine in particular has shown excellent CO2 sorption capacity.

Invention Description

Researchers at Arizona State University have developed L-Arginine incorporated polymer nanofiber composite mats for the direct air capture (DAC) of CO2. The amino acid L-arginine is incorporated onto a poly(vinyl alcohol) nanofiber support, creating porous substrates with very high surface areas of L-arginine available for the sorption of CO2. The nanofiber composites are fabricated from a single step electrospinning process using an aqueous polymer solution. The nanofiber mats showed excellent CO2 sorption capability and kinetics in initial tests.

Potential Applications

- Commercial CO2 capture technologies (e.g., flue gas capture)
- Low-cost DAC technology

Benefits & Advantages

- High sorption kinetics and capacity
- High surface area for CO_2 capture achieved from electrospinning
- Cost-effective and easy to manufacture
- Scalable & flexible
- Works for high and low concentrations of CO_2

Related Publication: Electrospun Poly(vinyl alcohol) – L-Arginine Nanofiber Composites for Direct Air Capture of CO_2