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1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Matthew Green
Mani Modayil Korah
Kyle Culp

Contact

Physical Sciences Team

Poly(Vinyl Guanidine) Polymeric Materials for CO2 Capture

Background

Anthropogenic CO2 emissions are one of the major contributing factors to climate change. Direct air capture (DAC) technologies extract CO2 directly from the atmosphere, and are one potential solution to combatting CO2 emissions. Poly(vinyl guanidine) (PVG) is a polymer that can be synthesized through free radical polymerization of vinyl formamide (NVF), then hydrolysis of the resulting PNVF. The PVG polymer becomes an active CO2 sorbent after anion exchange with hydroxide.

Solid PVG can be used to capture CO2 directly from the atmosphere, and a PVG polymer can be dissolved in water to make a PVG solution that shows excellent CO2 sorption capabilities. PVG can be shaped into nanofiber sheets to improve the surface area and increase sorption capability.

Invention Description

Researchers at Arizona State University have developed novel poly(vinyl guanidine)-based (PVG) polymeric materials that can passively capture CO2 directly from the atmosphere. The PVG polymer was shown to have excellent CO2 sorption capability both as a solid and as an aqueous liquid after counterion exchange with hydroxide. These materials can be regenerated with heat in air at 100C and can be electrospun into nanofibers to improve solid sorption kinetics.

In initial tests, the polymer showed CO2 sorption capabilities close to 700 µmol/g in a span of 2 hours when exposed to ambient air at high humidity. When air was bubbled through a 5% PVG solution, the capacity of the polymer was shown to be up to 4400 µmol/g (weight with respect to the PVG polymer)

Potential Applications

- Direct air capture (DAC) technologies
- Dilute industrial gas streams
- Life support systems in space cabin environments

Benefits & Advantages

- High capacity and kinetics
- Can be used in bulk, nanofibers, or liquid form depending on application
- Can be crosslinked to make the polymer compatible with steam regeneration
- Low regeneration energy requirement
- Enables passive DAC technology without the need for high energy pumps or compressors

- Can be used with other dilute streams
- Relatively simple synthesis method