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Sprayable engineered nanocomposite coatings for large-area carbon capture and conversion into useful by-products

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The development of economically viable and energy-efficient approaches for carbon dioxide (CO_2) capture/adsorption is critically important to mitigate climate change and preserve the ecosystem. CO_2 is a renewable feedstock, which can serve both as a reagent in chemical synthesis and as an environmentally benign solvent system. At present, given the depleting petroleum feed stocks that we heavily depend on to produce industrially important chemicals; it is of utmost importance that we develop new and novel uses for CO_2 in chemical synthesis and purification in order to curb global petroleum consumption. Hence, for a sustainable energy future, new materials and processes need to be investigated and developed that, in addition to capturing CO_2, would also convert it into useful chemicals/products including fuels. The major challenge, however, lies in activating stable CO_2. We show a novel approach of both CO_2 capture and conversion into commercially important chemicals using porous polymer nanocomposite materials. These multicomponent nanocomposites are comprised of combinations of different metal oxide nanoparticles and catalysts in a porous polymer matrix. In contrast to conventional single-component polymer membrane systems, our nanocomposites exhibit unique functional capabilities. This is because this material system provides numerous localized catalytically active hot reaction spots generated by the dispersed multifunctional oxide nanoparticles. This dramatically enhances CO_2 capture and conversion properties. The nanocomposite material system contains reactive metal catalysts, which, on reaction with in situ generated reducing gas forms a reactive species for further conversion of the captured CO_2 into useful by-products such as carbonate/bicarbonate, methane, methanol, formic acid etc. The integration of polymer materials with catalytically active nanomaterials shows a promising strategy for the enhanced CO_2 capture and conversion towards achieving a sustainable energy future.

Biography

Charles Magiera is a second year student at the University of Notre Dame, majoring in Chemical Engineering. Charlie's current research interests include carbon sequestration and solar cell technologies. He conducts research involving carbon-capture and conversion by means of polymer-based nanocomposites under Dr. Abhijit Biswas, a professor at Notre Dame. He hopes to continue research in this field throughout his undergraduate years and beyond, and is also interested in the commercial applications of his sustainable energy research.

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