Investigator: Nicole Buan
Position Title: Assistant Professor
Department: Biochemistry

Email: nbuan@unl.edu
Phone: (402) 472-7413

Webpage: http://agronomy.unl.edu/yang

Conversion of CO_2 and Carbonates to Methane and (bio)isoprene

Abstract.
We propose a biotechnology to simultaneously convert anthropogenic CO_2 or carbonate minerals from energy generation facilities into a biofuel (methane), and a bioproduct (isoprene),using microbial consortia. Carbon Capture and Utilization Strategies (CCUS) are critical to minimize emissions or remove anthropogenic CO_2 from the atmosphere. Yet, green technologies converting CO_2 to value-added products in addition to biofuels is lagging. To date, 30-40% of emitted CO_2 results from coal fired power plants and technologies have been developed to remove CO_2 from emissions. One of these technologies is the production of carbonate minerals such as calcium carbonate. Methane-producing microbial species in pure culture and in multi-organism microbial consortia are naturally capable of using anthropogenic carbonates or CO_2 for production of isoprene, which they incorporate into branched alkane lipids that constitute cell membranes. Isoprene is a valuable chemical commodity used in production of polyisoprene rubber (the major component of automotive tires), in styrene isoprene-sytrene (SIS) block copolymer adhesives, and as a synthetic intermediate for a wide range of specialty chemicals (cosmetics, vitamins, flavorings, etc). Microbially-derived isoprene is chemically identical to petroleum-derived isoprene, but can be extracted in higher yield and purity. This technology will be developed in two objectives: (Objective 1) quantify conversion of CO_2 and carbonates to methane and isoprene and (Objective 2) engineer methane-producing microbes to overproduce isoprene. These experimental objectives will be initiated in Year One in an effort to augment natural isoprene production in new and existing methane-producing microbial isolates or consortia. This technology will result in an inexpensive, economically feasible method to convert anthropogenic CO_2 and carbonates into an energy source and a commodity with increasing worldwide demand. Successful implementation will also result in a market for carbonates captured by power plants