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Single enzyme nanoparticles for carbon sequestration

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Biocatalysts have a significant role to play for addressing an important millennium development goal i.e. global warming/ climate change. However, with alarming increase in the level of CO_2 it is required to re-engineer the biocatalysts and biomimic the natural processes for fixing or storing carbon into some value added products to control the growing levels in a cleaner, greener and sustainable manner. A novel approach of enzyme stabilization, being pursued at NEERI to develop a new enzyme composite of nanometer scale called Single Enzyme Nanoparticle (SENs), comprising of each enzyme coated with organic / inorganic hybrid polymer of less than a few nanometers thick, which is further immobilized into nanoporous and mesoporous based materials.

By using this approach we can sequester the anthropogenic CO_2 into calcium carbonate by using carbonic anhydrase. It has been successfully tested for carbonation reaction. The CO_2 sequestration capacity for SEN is 1095 mg of $CaCO_3$ / mg of CA compared to CO_2 sequestration capacity of 257 mg of $CaCO_3$ / mg of CA for free CA under limiting concentration of CO_2 (14.5 mg of CO_2 / 10 mL).

Based on the protocol developed for SEN-CA, it is proposed to test the versatility of the process by using other enzymes like tyrosinase. SEN-tyrosinase has been developed for its application in humification reaction in a view of CO_2 sequestration through humus formation. SEN-tyrosinase immobilized on mesoporous iron oxide show the highest activity of 824 U/mg as compared to 625 U/mg for free enzyme. This may be attributed to synergistic effect between matrix and enzyme.

Biography

Renu Yadav is the senior research fellow of CSIR and doing her research work in the area of nanoparticles and its application for environmental bioremediation. She has published 10 papers in international reputed journals.

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