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Review

Energizing the CO_2 utilization by chemo-enzymatic approaches and potentiality of carbonic anhydrases: A review

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ABSTRACT

During the last few decades, enormous emissions of greenhouse gases (GHGs) into the atmosphere by human activities, lead to global warming. Thus, it becomes essential to prevent the excessive emission or to develop new technologies to avoid successive accumulation of CO_2. Biological systems in nature have the capability to fix the atmospheric CO_2 but in the urban and industrially developed areas where a rate of CO_2 emission is very high, the biological system cannot capture and utilize the whole CO_2. Various chemicals and synthetic materials with CO_2 absorbing property are not eco-friendly or these are very expensive. Carbonic anhydrase (CA) is the fastest known enzymes containing zinc in its active site, convert CO_2 to bicarbonate ions. It is one of a potent biological catalyst for CO_2 conversion. Thus, in order to reduce the level of CO_2 the biocatalytic properties of microbial CA can be exploited. Literature survey showed that, more than fifty different microbial CAs have been explored for CO_2 sequestration. The major advantages of CA to sequester CO_2 are economic viability and carbonation of CO_2 at a low concentration. Despite the higher rate of catalysis, the stability of CA is a major challenge for its industrial application. These difficulties have been partly solved by immobilizing the CA onto the bio-inspired surface, biochar, alginate, polyurethane foam and variety of nano-textured materials. A combination of enzyme and material which jointly capture and convert the CO_2 into either carbon-rich compound of economic value or reduced carbon derivatives will plausibly energize the CO_2 utilization. In this review, we discussed the recent advances in chemical and materials used for CO_2 capture, their advantages and limitations, utilization of microbial CA for CO_2 conversion, and its various applications.

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