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Codisplay of diisopropyl-fluorophosphatase (dfpase) and organophosphorus acid anhydrolase (opaa) enzymes in cell surface of e.coli

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Backgrounds: Pesticides used in controlling harmful populations of insects, can adversely affect human health and cause environmental pollution. The most popular pesticides are organophosphates (OPs) such as Diazinon, Chlorpyrifos, Malathion, etc. Several enzymes have been isolated able to degrade different kinds of OPs such as OPAA (from cytoplasm of *Alteromonas* sp.) and DFPase (from the brain of squid *Loligo vulgaris*). To reduce the OP uptake limitation and degrade a broader substrate spectrum with more activity, we demonstrate for the first time a functional codisplay of two distinct hydrolases, DFPase and OPAA, on a single bacterial cell, by fusing each enzyme to N-terminal of InaV (InaV-N).

Materials and Methods: To cotranslocate, target genes should be cloned in two different plasmids with two different antibiotic resistances and independent expression strategy, therefore, *inaV-N/dfpase and ina*V-N/*opaa* fragments were cloned into pET-28a(+) and pCDFDuet vectors, separately. Competent E. coli Bl21 cells were transformed by individual recombinant plasmids, as controls, and simultaneously both one by electroporation method.

Results: Studies on activity by FPLC with DFPase, OPAA and codisplay cells showed a specific activity of 19.676, 13.125 and 22.46 U/ml, respectively, for Diazinon, and 10.779, 5.213 and 13.784 U/ml, respectively, for Chlorypyrifos. Study on activity by monitoring fluoride-release from DFP by each miligram of DFPase, OPAA and codisplay wet cells showed 500, 250 and 800 Unit, respectively.

Discussion: Findings showed a recombinant strain possesses a broader substrate spectrum and a more activity than strains expressing either one of the hydrolases, a whole-cell biocatalyst candidate to detoxify environment polluted by different OPs.

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Electrochemical reactor design/fabrication for CO_2 electroreduction to low-carbon fuels/chemicals

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Extra emission of carbon dioxide (CO_2) into the atmosphere, induced by human industrial activities, has been considered one of the primary causes in possible global warming due to the greenhouse effect, and also becoming an increasing concern in recent years. To address this issue, using electrochemical reduction to convert CO_2 to useful small fuels such as CH_4, CH_3OH, HCOOH, C_2H_2, etc., represents a value-added approach to the simultaneous generation of alternative fuels and environmental remediation of carbon emissions from the continued use of conventional fuels. Many references in the literature have focused on studies with improving the performance of electrochemical process to convert CO_2 into low-carbon fuels/chemicals. For reactor components, both anodes and cathodes are discussed in terms of their materials, structure, design, fabrication, as well as their effects on the reactor's performance and productivity. Several important electrodes are described including metallic electrodes, gas diffusion electrodes (GDEs) and modified metal electrodes in both aqueous and non-aqueous electrolyte solutions. Both the ion-exchange membranes for low-temperature operation, and the solid oxide electrolyte layers for high-temperature operation, can serve as both functions of ion conduction and electrode separating. Regarding the electrochemical reactor design/assembling/fabrication for CO_2 reduction, several types of the reactors, including the conventional three-electrode cells, the low temperature two-electrode cells using proton exchange membrane fuel cell (PEMFC) technology, the solid oxide electrolysis cells (SOECs) and the microbial electrolysis cells (MECs), as well as other electrolysis cells, are introduced and their performances are also analyzed. The potential and feasibility of the reactor scale-up for CO_2 conversion to low-carbon fuels/chemicals is discussed with respect to the technology's commercialization.

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