Immobilization of alcohol dehydrogenase on ceramic silicon carbide membranes for enzymatic CH₃ OH production

BACKGROUND Alcohol dehydrogenase (ADH; EC 1.1.1.1) catalyzes oxidation of CH₃OH to CHOH during NAD⁺ reduction to NADH. ADH can also accelerate the reverse reaction, which is studied as part of cascadic enzymatic conversion of CO₂ to CH₃OH. In the present study, immobilization of ADH onto macroporous membranes of silicon carbide (SiC) was investigated for CHOH to CH₃OH conversion.

RESULTS Immobilization techniques included physical adsorption directly to the membrane and functionalization of the membrane with polyethylenimine (PEI) or (3-aminopropyl)triethoxysilane (APTES) followed by glutaraldehyde (GA) cross-linking. Enzyme loadings, flux, NADH conversion, and overall ADH reusability were assessed. Enzyme loadings were similar, but substrate conversion was approximately 2 and 2.5 times higher for APTES-GA and PEI-GA, respectively, and the relative activity retention was better than for physical adsorption. Membrane surface treatment with NaOH prior to APTES-GA immobilization resulted in significant improvement in enzyme loading and a doubling of ADH activity as well as higher activity during recycling as the ADH destabilization rate was unaffected.

CONCLUSIONS The results provided proof-of-concept for the use of NaOH-treated SiC membranes for covalent enzyme immobilization and biocatalytic efficiency improvement of ADH during multiple reaction cycles. These data have implications for the development of robust extended enzymatic reactions.

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