Alcohol dehydrogenase on inorganic powders: Zeta potential and particle agglomeration as main factors determining activity during immobilization - DTU Orbit (20/12/2018)

Alcohol dehydrogenase from Saccharomyces cerevisiae was immobilized on different inorganic support materials, i.e. powders of Al₂O₃, SiC, TiO₂, and YSZ-8, by covalent bonding and physical adsorption. The raw powders were characterized by scanning electron microscopy, BET surface area, particle size distribution and ζ-potential measurements. Enzyme activity retention, storage stability and recyclability were evaluated on the basis of the measured support material properties. Preliminary experiments showed that the buffer selection was a critical factor. The properties of both the enzyme and the powders varied considerably between the buffers used; namely Tris-HCl (100 mM, pH 7) and MES (40 mM, pH 6.5) buffers. The enzyme activity was higher and more stable in the MES buffer, whereas the commonly used Tris buffer was problematic due to apparent incompatibility with formaldehyde. In MES, the order of decreasing activity of covalently bonded enzyme was on SiC > YSZ-8 > Al₂O₃ > TiO₂. The lower performance of TiO₂ was ascribed to the negative ζ-potential of the material, which impeded an efficient immobilization. Particle agglomeration, caused by low colloidal stability of the particles in MES buffer, hampered the storage stability of the immobilized systems. The results from this study show the advantages and limitations of using nanoparticles as immobilization supports, and highlight which properties of nanoparticles must be considered to ensure an efficient immobilization.