BIOMIMETIC HYBRIDS FOR MULTIFUNCTIONAL NANOREACTOR CREATION

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The research is aimed at creation of nanoscale biocatalyst which is effective under industrial hydrolysis conditions. Pathways for preparation of multi-purpose organic/inorganic matrix based on non-toxic biocompatible and biodegradable compounds –cyclotriphosphazene and polyglutamic acid are elaborated. Molecular architecture of biomimetic nanoparticle is studied (trans-oriented 3 α-helix bundles). Conventional methods of physical chemistry (optical spectroscopy, SWAXS, DCS etc.) as well as computer simulation which included geometry optimization, electron density calculations etc. have been applied for structural study. It was shown that biologically active ingredients (enzymes) can be introduced to the matrix; fully substituted and non-fully substituted products can be obtained. In case of non-fully substituted products free amino-groups can bind to biological substrates while biologically active fragments may participate in other reactions, in our case enzymatic cleavage.

Purified and extracted substances – ribonuclease and lipase were immobilized at hybrid matrix at all reaction centers. The complex was well soluble in alcohol, partially soluble in water. Its enzymatic activity was very high in reactions with yeast ribonuclease. An increased active centers density allows to decrease the concentration of the reagent which is more active than non-immobilized enzyme at $t<60\ ^0C$ and at $pH<4$. It was shown that under industrial conditions the substrate splitting passes faster when applying the hybrid matrix. The catalyst continues to act under addition of new amounts of the substrate. The process of the enzymatic hydrolysis catalysed by multi-centered nanobiocatalyst will be extensively studied in future.

The data obtained show that nanoreactor is stable in acidic medium and that hydrolysis rate is 30 % faster than for pure (“free”) enzymes.

References:

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Figures: