Stabilisation of enzymes against thermal inactivation through the attachment to surface modified poly-functional polymeric nanoparticles

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Enzyme modification and immobilization have been extensively studied and utilized to generate biocatalysts with improved stability and selectivity as well as applications in sensing and enzyme-related biotechnology. The major hindrance in developing enzyme related therapy is its inherent thermal instability and drop in activity with sometimes minute thermal fluctuations. This necessitates the use of repeated injections or local infusions for a period of days to weeks which are invasive, infection-prone, and clinically problematic. A novel strategy for enhancing thermal stability is through non-covalent surface interaction with the large surface area at the nanometer-scale. Our study investigates the thermal stabilization of a range of enzymes through physisorption to a multimodal polymeric nanoparticle system. The nanoparticle system contains both a fluorescent probe commonly used in fluorescent microscopy as well as magnetite nanoparticles, which will allow for both magnetic imaging and enzyme recovery post treatment. The surfaces of the nanoparticles have been modified with either polyethyleneimine (PEI) or polyethylene glycol (PEG) to ultimately enhance not only the attachment of different enzymes to the nanoparticle but also increase their tolerance to thermal denaturing.

Preliminary studies with a β-glucosidase and phosphatase, both enzymes of significant interest to industry, have shown a strong physisorption of the enzyme to the PEI modified nanoparticles.

Figure 1. TEM image with EFTEM insert of the multimodal polymeric nanoparticles. Scale bar 100nm.