

Publication

ATRPases: enzymes as catalysts for atom transfer radical polymerization

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Atom transfer radical polymn. (ATRP) is a powerful synthetic tool that is commonly used in polymer chem. This controlled radical polymn. leads to the synthesis of well-defined, end-functionalized polymers with complex mol. architectures. We discovered that heme proteins such as Hb (Hb) and horseradish peroxidase (HRP) catalyze the polymn. of vinyl monomers in the presence of ATRP-initiators and the reducing agent ascorbic acid under conditions typical of activators regenerated by electron transfer (ARGET) ATRP. We call this novel biocatalytic activity ATRPase activity. It yields bromine-terminated polymer chains with polydispersities as low as 1.2. The reaction kinetics were of first order, and for some monomers such as poly(ethylene glycol) Me ether acrylate (PEGA), the polymers' mol. wts. increased with conversion. These findings show that ATRPase activity is a controlled polymn. that involves reversible bromine-atom transfer between the growing polymer chain and the protein. ATRPases could become 'green' alternatives to the transition metal complexes that are currently used as catalysts for ATRP, because proteins are non-toxic, derived from renewable resources, and (e.g. in the case of Hb) cheap and abundantly available.

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