Chlorophyll Cysteine Co-catalyzed Biodegradable Poly (Methyl 2-methylpropenoate)

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Poly(methylmethacrylate) (PMMA) plastic, also known as poly(methyl 2-methylpropenoate), has played an important role in the field of polymer science on grounds of its characteristic properties of hard, tough, transparent and chemically inert. Nevertheless, PMMA performs weak biodegradability and requires thousand years to be completely degraded in ocean and soil. Marine animals may carelessly ingest the plastic pellets in ocean and cause devastating effect to ecosystem. In this project, I introduce a cost-effective and green polymerization using chlorophyll as radical initiator and cysteine as catalyst. The photo-initiated polymerization gave a promising yield of 82% using chlorophyll (0.00067 eq.), cysteine (0.0050 eq.), detergent (0.22 eq.) and MMA monomer (1.0 eq.) in equivalent volume of hexane-water solvent mixture under optimum temperature of 80°C with production cost of US$0.026 per gram. Physical and chemical property have also been investigated. Chlorophyll cysteine co-catalyzed PMMA possessed hardness between 2 and 2.5 in Mohs scale which is equivalent to the hardness between fingernail and aluminum and also possessed decomposition temperature between 270°C and 290°C. For chemical resistance, 88%, 42% and 40% of PMMA remained after introducing 3 M of ethanol, sodium hydroxide and ammonia respectively after 240 h. Also, the PMMA showed outstanding biodegradability after employing amylases for 72 h at pH 7 buffer solution while commercially purchased PMMA showed negligible biodegradability. This innovative polymerization, I believe, will be the milestone for yielding environment-friendly, affordable and biodegradable PMMA in the future.

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