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Biocompatible and biodegradable PLA-copolymers biosynthesized by microbial platform from renewable feedstock

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Our study is a typical synthetic biology for value-added products like polymeric materials. Representative bio-based polyester, polylactide (PLA), can be synthesized via heavy metal-catalyzed ring-opening polymerization of lactide derived from fermented lactic acid (LA). In 2008, for the first time, we succeeded in incorporating D-form of LA (D-LA) into the 3-hydroxybutyrate (3HB) polymeric backbone in the Escherichia coli-based microbial platform carrying a newly developed D-LA-polymerizing enzyme (LPE). LPE was one of the artificial enzyme for polyhydroxyalkanoates (PHA) synthesis through our long-term directed evolution study. Discovery of LPE allowed us to further create the unnatural monomer-contained PHA members other than LA-based polymers. Using LPE I expect to synthesize the chiral copolymers with diverse monomers, owing to both high enantio-selectivity and broad substrate specificity. In this symposium, I will talk about the overview of biosynthesis, various properties of LPE-catalyzed polymers. We have currently attempted to develop the consolidated bioprocess for production of the target polymers from renewable feedstocks. To date I have been thinking about the possibility of "SECRETION" of polymerized ester-products by microbial platform. This should be a promising issue to overcome the cell volume limitation in the large amount of production of microbial polymers. Fortunately, we met to the "SECRETION" of low-molecular-weight D-LA-based polymers [or D-LA-based oligomers (D-LAOs)]. As a second topic, I will talk about the first observation of microbial secretion of D-LAOs and its advanced microbial secretion platform through the chain transfer reaction and modified cultivation conditions Furthermore, synthesis of lactate (LA)-based poly(ester-urethane) using hydroxyl-terminated LA-based oligomers based on the microbial secretion system will be presented.

Biography

Dr. Seiichi TAGUCHI is a Professor of Biomolecular Chemistry in Tokyo University of Agriculture. He received a Ph.D. in Molecular Biology in 1991 from The University of Tokyo. After that, he joined the faculty of Bioscience and Engineering as an Assistant Professor at the Tokyo University of Science. During the period, he was a Visiting Scientist of Louis Pasteur University. After spending the decade, he joined the Polymer Chemistry Lab. in RIKEN Institute as a Senior Research Scientist. He moved to Meiji University as an Associate Professor in 2002 and was promoted to Professor of Hokkaido University in 2004, and shifted to the present position in 2017. He has received several awards such as Prizes for Science and Technology, The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (MECST). He has published over 180 original research papers and over 30 books to his name.

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