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Preparation of functionalized PCL-based materials for biomedical application

So far, aliphatic polyesters, especially, poly(glycolide) (PGA), poly(lactide) (PLA), poly(e-caprolactone) (PCL) and their copolymers have withdrawn much attentions as biodegradable polymeric materials, because of their superior properties, such as mechanical strength, easiness of polymerization and manufacturing, biodegradability, and so on. Among them, there are many PCL-related researches as biodegradable materials have been already used as artificial dura mater clinically. We have reported that surface shape memory materials derived from PCL could contributed to mechano-biological studies using the same materials with modulated elasticity and viscosity by only temperature change. Furthermore, drug permeation control near body temperature could be succeeded by effective melting point modulation. In this study, new PCL network material which has cationic groups is prepared. The cationic moieties would interact to anionic groups easily, for example sialic acid in sugar chains. As other functional materials, we have been studying the methodology to introduce functional materials into the PCL main chains for immobilization of bio-active molecules, So such polymeric materials are expected to interact to living cells or tissues. To achieve such purpose, we newly designed blanched PCL macromonomer which has bromomethyl groups at the all of chain ends. Then, these terminal halomethyl groups reacted to 2, 2'-dimethylaminoethyl methacrylate to afford the objective macromonomer as seen in Figure 1. The corresponding macromonomer solution was cast and UV light was irradiated in the presence of photo-sensitizer. Briefly, 4-blanced PCL were prepared by ring opening polymerization initiated with pentaerythritol. Hydroxy groups at the chain ends reacted bromoacetyl bromide. The reaction with 2,2'-dimethylaminoethyl methacrylate afforded the N-methacryloylethyl, N', N"-dimethylammonio- terminated PCL macromonomers. This cationic PCL macromonomer THF solution were poured into the space of two glass plates with the Tefron spacers. To both sides of the glass plates, UV light was irradiated for cross-linking reaction to obtain membrane-type materials. The surface properties of the cationic PCL cross-linked membrane were evaluated by contact angle measurement of water droplet and anionic compound. As expected, the cationic PCL cross-linked membrane showed larger hydrophilicity and the much greater dye adsorption than the naked PCL. These results suggest that such materials would enhance the living cells interaction and be useful for protein immobilization on the surfaces.

Figure 1 Preparation of cationic PCL-based macromonomer

Biography

Dr. Takao Aoyagi is Professor of Department of Materials and Applied Chemistry of Nihon University in Tokyo, Japan. He received his Ph.D. at Tokyo Institute of Technology in 1993. After finishied Graduate School of Science and Engineering of Waseda University, he belonged to a Japanese chemical company (Lion Corporation, 1986-1987) and private institute (Sagami Chemical Research Center, 1987-1995). He became an assistant professor at Institute of Biomedical Engineering in 1995 and associated professor in 2001, Tokyo Women's Medical University. In 2002, he was promoted to full professor of Department of Nanostructure and Advanced Materials of Kagoshima University. In 2009, he moved to the Biomaterials Center and Coordinating Director of Nanotech-driven Materials Research for Biotechnology, National Institute for Materials Science (NIMS) in Tsukuba, Japan. His present research field is design of smart biomaterials for biomedical applications.

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