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Kazunori Kataoka, Ph.D. is Professor of Biomaterials at Graduate School of Engineering, the University of Tokyo, Japan. He has been appointed joint position since 2004 from Graduate School of Medicine, the University of Tokyo as Professor of Clinical Biotechnology at Center of Disease Biology and Integrative Medicine. Dr. Kataoka received several awards, including the Society Award from the Society of Polymer Science, Japan (2000), Clemson Award from the Society for Biomaterials USA (2005), Founder’s Award from the Controlled Release Society (2008), Humboldt Research Award (2012), Leo Esaki Prize (2012), and Gutenberg Research Award (2015). He served as the president of Controlled Release Society (2012-13). His current major research interest is supramolecular materials for nanobiotechnology, particularly focusing on drug and gene targeting, and has published more than 500 papers with high citations as selected as “Highly-Cited Researchers” by Thomson Reuters.

Supramolecular Nanosystems from Functionalized Block Copolymers for Smart Targeted Therapy of Intractable Diseases

Nanotechnology-based medicine (Nanomedicine) has received progressive interest for the treatment of intractable diseases, such as cancer, as well as for the non-invasive diagnosis through various imaging modalities. Engineered polymeric nanosystems with smart functions play a key role in nanomedicine as drug carriers, gene vectors, and imaging probes. This presentation focuses present status and future trend of the development of self-assembled nanosystems from block copolymers for the therapy of intractable diseases.

Nanosystems with 10 to 100 nm in size can be prepared by programmed self-assembly of block copolymers in aqueous entity. Most typical example is polymeric micelles with distinctive core-shell architecture. Several micellar formulations of antitumor drugs have been intensively studied in preclinical and clinical trials, and their utility has been demonstrated. Compared with conventional formulations, such as liposomes, polymeric micelles have several advantages, including controlled drug release, tissue penetrating ability and reduced toxicity. Critical features of the polymeric micelles as drug carriers, including particle size, stability, and loading capacity and release kinetics of drugs, can be modulated by the structures and physicochemical properties of the constituent block copolymers. The development of smart polymeric micelles that dynamically change their properties due to sensitivity to chemical or physical stimuli is the most...
promising trend toward nanomedicines, directing to the targeting therapy with high efficacy and ensured safety. Notable anti-tumor efficacy against intractable cancer, including pancreatic cancer, of antitumor drug-incorporated polymeric micelles with pH-responding property was demonstrated to emphasize a promising utility of nanomedicines for cancer treatment. Versatility in drug incorporation is another feasibility of polymeric micelles. Polymeric micelles loaded with oligonucleotides, including siRNA, have been successfully formulated with relevant properties for nanotherapeutics, such as penetrability into diseased sites in the body to reveal significant silencing of disease-related genes by simple systemic injection. These results demonstrate the promising features of polymeric micelles as platform nanosystems for molecular therapy of various intractable diseases through the selective delivery of a variety of drugs having issues on pharmacokinetics and pharmacodynamics.