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Functional polyaspartamide polymer-based nanoformulations: From synthesis to recent biomedical applications

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Several polymers and their derivatives have been extensively utilized for diverse biomedical applications over the past decades. In general, these polymers fruitfully participate in the surface modification of hydrophobic inorganic nanoparticles such as iron oxide and quantum dots to make highly colloidal stable and water-soluble nanoparticles which mainly perform as imaging contrast agents. Additionally, the polymeric nanoformulations demonstrate the excellent capability to deliver the different therapeutic agents (e.g. drug molecules, nucleic acids and proteins) into the diseased cells/tissues. Among various polymers, the exceptional biocompatibility and biodegradability characteristics of functional polyaspartamide polymers construct them as more appropriate candidates for biomedical applications. Therefore, in recent years, various functional polyaspartamide polymers have been well designed and prepared and subsequently, their different nanoformulations (e.g. micelles, nanoparticles and polyplexes) have been productively applied for many preclinical studies in biomedical research. In this regard, the design and synthesis of functional polyaspartamide polymers are more important to improve diagnostic and/ or therapeutic efficiency. The large-scale synthesis of the intermediate polymer polysuccinimide is well established. The most commonly employed methods are based on thermal polycondensation and ring-opening polymerization techniques. Its further functionalization onto the polymer backbone with essential pendant molecules is highly facile to achieve the desired functional polyaspartamide polymers. As a result, various types of functional polymers can be easily prepared that offer many beneficial properties like stimuli-responsive degradability and enhanced binding ability. Consequently, the application of these functional polymers in various biomedical fields is more successful. In particular, functional polymers are widely used as surface modifiers to develop water-dispersible inorganic nanoparticle-based bioimaging contrast agents for diagnosis and image-guided therapy. In contrast, various polymeric nanocarriers based on functional polymers are more useful for the safe transportation of therapeutic agents for the effective treatment of many diseases. Besides, these polymers have high potential in other biological fields including agriculture.

Recent Publications

1. Sourov Chandra, Pradip Das, Sourav Bag, Dipranjan Laha, Panchanan Pramanik. Synthesis, functionalization and bioimaging applications of highly fluorescent carbon nanoparticles. Nanoscale. 2011; 3(4): 1533-1540

2. Aniruddha Kundu, Sudipta Nandi, Pradip Das, Arun K Nandi. Fluorescent graphene oxide via polymer grafting: an efficient nanocarrier for both hydrophilic and hydrophobic drugs. ACS applied materials & interfaces. 2015; 7(6): 3512-3523

3. Pradip Das, Nikhil R Jana. Highly colloidally stable hyperbranched polyglycerol grafted red fluorescent silicon nanoparticle as bioimaging probe. ACS Applied Materials & Interfaces. 2014; 6(6): 4301-4309.

Speaker Biography

Pradip Das obtained his B.Sc. (Hons) in 2009 and M.Sc. in 2011 in Chemistry from Vidyasagar University, India and the Indian Institute of Technology Kharagpur, India, respectively. He received his Ph.D. in Chemistry from Indian Association for the Cultivation of Science, India in 2016 under the supervision of Prof. Nikhil R. Jana. He completed his first postdoctoral research with Prof. Ulrich J. Krull from the University of Toronto Mississauga, Canada. Then he joined as a postdoctoral fellow at the University of Milano-Bicocca, Italy, for his second postdoctoral research with Prof. Davide Prosperi. He recently finished his postdoctoral research with Dr. Teresa Pellegrino at the Italian Institute of Technology Genova, Italy. Nowadays, he is working as a Marie-Curie postdoctoral fellow with Dr. Jean-Olivier Durand at the Institute Charles Gerhardt Montpellier, CNRS, France. He has published 26 papers that have been cited more than 1440 times.

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