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Dopamine-functionalized polypyrrole nanostructures

Surface modification and functionalization of polymers are playing increasingly important roles in the development of new functional materials with desired properties for applications in the advanced manufacture, energy, healthcare etc. Polypyrrole (PPy) is one of the most interesting and well-studied electrically conductive polymers because of its long-term stability and good biocompatibility. However, PPy is difficult to be further functionalized and processed because PPy is in a form of black precipitate that is insoluble in water and in most organic solvents, and has a weak adhesion to surface. In this talk, I will review our recent research development on the use of catechol chemistry for the functionalization of polypyrrole and the fabrication of varied catechol-polypyrrole nanostructures with tunable morphologies and conductivities and discuss their potential applications. Inspired by the catechol and amine functional groups found in the adhesive proteins of marine mussels, we have exploited one of the simplest catecholamines, dopamine (DA), for surface modification and functionalization of PPy. Even though dopamine is insulating, adding a small of dopamine can surprisingly increase the conductivity of polypyrrole. We attributed this feature to the molecular adhesion of dopamine with polypyrrole resulting in the formation of hydrophilic core/shell nanofibers, which are readily dispersible and provides more effective electrical pathways than the globular nanoparticle without dopamine. It was also found that the morphology and conductivity of the dopamine (DA)-functionalized polypyrrole (Py) could be finely controlled by the DA/Py reaction ratio. For instance, at higher reaction ratios, we observed the morphologies of nanoflakes, which are less conductive but can be used in electromagnetic interference shielding applications.

Biography

Boxin Zhao is a tenured associate professor at the University of Waterloo. He has created and directed the Laboratory of Surface Science and Bionanomaterials, working on both fundamental and applied research. He has 180 publications in total; 89 are peer-refereed papers on the top journals including Langmuir, Macromolecules, Advanced Materials, and Advanced Functional Materials, PNAS. The current research interests of his group are in the areas of polymers and multifunctional composites, interfacial technologies and surface science, biomimetic adhesion and adhesives, 3D printing, interfacial phenomena and contact dynamics in polymers and biological systems.

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