Selective Modification of Snowman type Janus nanoparticles with Polypyrrole

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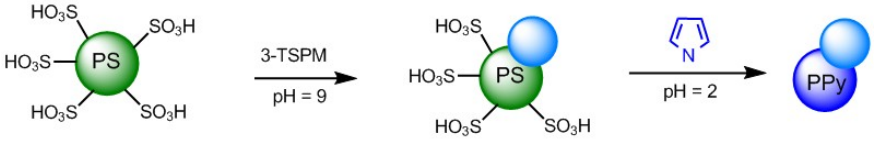
Nanoparticles of conjugated polymers such as polypyrrole (Ppy), Poly(3,4-ethylenedioxythiophene) (PEDOT) and polyaniline (PANI) show many attractive features in a wide range of applications, ranging from optoelectronic to electrochemical devices.[1],[2] Homogeneous or core-shell nanoparticles of the mentioned conductive polymers have been synthesized in order to improve their processability. On the other hand Janus nanoparticles (JNPs) have received considerable attention because of their amphiphilicity, stemming from a polarity contrast between two or more surface regions. Unlike molecular surfactants JNPs can additionally carry bulk-like optical, electronic or magnetic properties. For example multifunctional JNPs that can be both amphiphilic and conductive could find use in a plethora of new applications, such as conductive inks. In this work we demonstrate that it is possible to combine such properties and obtain multifunctional amphiphilic and conductive JNPs by selective modification of only one lobe with PPy.

The JNPs were obtained starting from polystyrene (PS) seed nanoparticles (NPs) on which grew Janus lobes of different sizes via seed polymerization and phase separation of the 3-(triethoxysilyl)propyl-methacrylate (3-TSPM) monomer.[3] The selective modification of the JNPs was achieved in two steps, first selective interaction attraction of pyrrole monomer into the PS lobe followed by diffusion–interfacial polymerization resulting in the formation of a core-shell structure, see Figure. By increasing the size of the P(3-TSPM) lobe with respect to the PPy/PS lobe we were able to tune the conductivity of the powder material by an order of magnitude from 10^{-4} to 10^{-5} S cm^{-1} while in the same time there is a six-fold increase in the polarity of the material. We have therefore demonstrated the possibility to obtain new multifunctional materials by selective modification of Janus lobes.



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