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SURFACE-GRAFTED POLYMER BRUSHES WITH LADDER LIKE ARCHITECTURE

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Recent progress in supramolecular chemistry leads to Surface grafted polymer brushes refer to an assembly of macromolecules attached with one end to a surface and stretched away from it. The stretched conformation of the tethered chains and their conformational freedom leads to unique properties of the brushes and specific applications. Conductive polymer brushes grafted from surfaces, as examples of such structures, are very desirable for e.g. organic photovoltaics and molecular electronics since they would form directional nanoscale pathway for charge transport. However, synthesis of surface-grafted conjugated polymer brushes is still very challenging since there are no controlled polymerization techniques easily applicable for that purpose. We have introduced self-templating surface-initiated polymerization (ST-SIP) leading to synthesis of ladder-like brushes with one chain in a pair being conjugated. Iniferter-based photopolymerization was applied to obtain the macromonomer brushes grafted from gold surface and containing acetylene side groups. The pre-aligned groups subsequently reacted forming conjugated chains. Such obtained brushes after doping exhibited high conductivity in the direction perpendicular to the surface as showed using conductive atomic force microscopy. The general route was later used for synthesis of poly(thiophene)-based brushes and polyelectrolyte conjugated structures and may be easily applied for obtaining other polymer architectures comprising conjugated polymers (mixed brushes, block conductive-nonconductive brushes etc.). Using similar approach, photoactive polymer brushes with ordered phthalocyanine chromophores were also synthesized. Conjugated polymer brushes based on e.g. poly(acetylene) and poly(thiophene) with such ladder-like architecture were also shown to exhibit long term stability in air as compared to polymer films and brushes composed of single chains. The conjugated and photoactive ladder-like brushes are very promising for applications requiring high ordering of the chains and long term stability such as organic photovoltaics, nanoelectronics or fabrication of energy-storage devices.

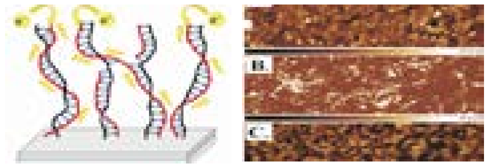

Figure 1: : (Left) Scheme of conjugated ladder-like brushes with ionic groups based on pyridine. (Right) Atomic force microscopy images of those brushes captured in topography(A), current (B), and adhesion (C) modes..

Recent Publications

1. Szuwarzyński M, Kowal J and Zapotoczny S (2012) Self-templating surface-initiated polymerization: a route to conductive brushes. J. Mat. Chem. 22(38):20179-20181.
2. Wolski K, Gruszkiewicz A and Zapotoczny S (2015) Conductive polythiophene-based brushes grafted from ITO surface via self-templating approach. Polym. Chem. 6:7505.
3. Wolski K, Szuwarzyński M and Zapotoczny S (2015) A facile route to electronically conductive polyelectrolyte brushes as platforms of molecular wires. Chem. Sci. 6(3):1754-1760.
4. Szuwarzyński M et al. (2017) Photoactive surface grafted polymer brushes with phthalocyanine bridging groups as an advanced architecture for light harvesting. Chem. Eur. J. 23:11239.
5. Szuwarzyński M, Wolski K and Zapotoczny S (2016) Enhanced stability of conductive polyacetylene in ladder-like surface-grafted brushes. Polym. Chem. 7 (36):5664-5670.

Biography

Szczepan Zapotoczny is a Professor at Jagiellonian University in Krakow (Poland) where he also completed his PhD in Chemistry working on synthesis and photophysics of polymeric photosensitizers. He joined the group of Professor G J Vancso (University of Twente, The Netherlands) as a Postdoctoral Researcher (1999-2001) working on force spectroscopy and surface chemistry of self-assembled systems. After coming back to Poland he focused his research on amphiphilic polymers obtained using controlled radical polymerizations and formation of photoactive polyelectrolyte multilayer films. Later on he initiated the studies on surface-grafted polymer brushes cooperating also with Professor Vancso. His current interests focuses on nanostructured polymeric and hybrid materials including films, brushes (conductive, stimuli-responsive), polymer coated nanoparticles, nanocapsules for photochemical and biomedical applications. He is a coauthor of 100 scientific papers and 6 patents.

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