JOINT EVENT
22nd International Conference on
Advanced Materials and Simulation
&
22nd Edition of International Conference on
Nano Engineering & Technology

December 10-12, 2018
Rome, Italy

Jayakrishnan A. J et al., Nano Res Appl 2018, Volume 4
DOI: 10.21767/2471-9838-C7-027

Design and Fabrication of Functionalized, Chiral Poly(3,4-ethylenedioxythiophene) (PEDOT) Nanostructures for Biosensing Applications

Jayakrishnan A. J[1,2,3] Udesh Dhawan[1], Tharwat Mansoure[1] and Hsiao-hua Yu[1,2]

[1]Smart Organic Material Laboratory, Institute of Chemistry, Academia Sinica, Taipei, Taiwan
[2]Taiwan International Graduate Program (TIGP), Sustainable Chemical Science & Technology (SCST),
3Dept.of Applied Chemistry, National Chiao Tung University (NCTU), Hsinchu, Taiwan

Nanotopological cues can be exploited to investigate the molecular interactions between biomolecules and nanomaterials. However, studies highlighting the synergistic effect of nanostructure shape, size and geometry in modulating biosensing parameters are non-existent. To explore this, poly(3,4- ethylenedioxythiophene) bearing hydroxyl functional group in the side chain having R or S chirality with dot and tube morphology were synthesized and the synergistic effect of polymer chirality and nano-topography morphology in controlling the biomolecule-polymeric nano-surface binding affinity were studied. Accordingly, the design of a bio-sensing nanosurface for enhanced sensitivity and signal/ noise ratio is proposed. Chiral polymers were synthesized via electrochemical polymerization using cyclic voltammetry or chrono-amperometry techniques. The formation of polymers was confirmed through UV/ Visible spectrophotometry and Fourier Transform Infrared spectroscopy (FTIR) while the chirality was confirmed through circular dichroism (CD). Hydrophobicity or hydrophilicity of the polymeric nanostructures was analysed by measuring their respective water contact angles. Electrochemical polymerization temperature was varied to obtain either nanodot or nanotube morphology while the potential was changed to modulate the nano-topography size. The nanostructure morphology was confirmed using Scanning Electron Microscopy (SEM). Fetal Bovine Serum (FBS) was used as a model protein and Quartz crystal microbalance (QCM) was used to analyse the binding affinity of biomolecules to different chiral nanostructures. Water contact angle measurement confirmed that, nanotubes showed a greater hydrophilicity as compared to dots irrespective of the chirality. Finally, QCM data revealed a 15 and 20Hz difference in the binding affinities of R and S-PEDOT when the nanostructure morphologies were same and a 12 and 17Hz difference in the binding affinities when the polymer chirality were same, confirming that polymer chirality and nanostructure morphology play a crucial role in determining the binding affinity of biomolecules to nanostructures. These results collectively indicated the existence of a fine balance between nanostructure and analyte size, which has to be optimized to achieve maximal bio sensing response. Applications in the field of bio-materials and biomedical engineering are expected.

Biography

Jayakrishnan A.J is expertized in designing of organic molecules for various applications. He is currently working on the design, synthesis and electrochemical fabrication of conducting polymer nanostructures, especially functionalized poly (3,4- ethylenedioxythiophene) for various material as well as biological applications. He is pursuing his doctoral studies in Institute of Chemistry at Academia Sinica, Taiwan with the prestigious Taiwan International Graduate Program (TIGP) scholarship.

jayakrishnanaj@gate.sinica.edu.tw