Abstract

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Journal of Biomedical Science & Applications

2021
Vol 5. S4

Superlattice Assembly of Alternately Stacked Hydroxide Nanosheets and Graphene Layers for Electrochemical Sensing of Biomolecules

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Abstract

The development of molecular-scale hybridized template of vertically stacked 2D superlattice materials with tunable interior architectures holds crucial role in various promising technologies, but the molecular-scale alternate stacking in hybrid material could be much more challenging. Herein, we have established a self-assembly of periodic superlattice material by integrating positively charged semiconductive sheets of Zn-NiAl layered double hydroxide (LDH) with reduced graphene oxide (rGO) layers known to be negatively charged by controllable co-feeding protocol and explored its practical applications in ultrasensitive, discriminative, and simultaneous detection of early diseases diagnosis biomarkers including dopamine (DA), uric acid (UA) and ascorbic acid (AA). Due to the harvested synergistic effect of drastic interfacial conduction imparted by direct neighboring of conductive graphene to semiconductive channels of LDHs in heteroassembly, superb intercalation feature of LDHs and enlarged surface area with enormous surface active sites, Zn-NiAl LDH/rGO modified electrode presents incredible electrocatalytic activity towards the oxidation of these biomolecules. The proposed biosensor has revealed outstanding electrochemical performances in terms of good selectivity, ultrasensitivity, broad linear ranges and low real detection limit of 0.1 nM and 0.9 nM for DA and UA, respectively. And its successful utilization in electrochemical sensing system for real-time tracking of neurotransmitter DA efflux from live human nerve cells has been validated. Therefore, our molecular-scale hybridized superlattice strategy using graphene as π-electron-rich substrate to modulate electronic structure of LDHs will open new horizon in material engineering, biosensing platform and pathological diagnostics.

Biography

Muhammad Asif has completed his PhD at the age of 31 years from Huazhong University of Science and Technology (HUST), China and postdoctoral studies from School of Chemistry and Chemical Engineering, HUST. Currently, he is postdoc fellow in School of Materials Science and Engineering, Wuhan Institute of Technology, China. He has published more than 50 papers with commulative Impact Factor of 346, in reputed journals like BB, AC, CEJ, ACS-AMI, SNB, advances in colloid and interface science and has been serving as an editorial board member of Frontiers in Chemsitry, Frontiers in Analytical Science.

