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Multi-dimensional and multi-functional hierarchical nanostructure for high performance sensing to trace-level dopamine molecules

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For most of biochemical sensing applications, the ideal material are claimed to have multifunction such as the capability of molecular recognition, enrichment of analytes and anti-interference ability. To meet the multiple requirements, herein a novel nano-architecture with multi-dimension and highly favorable properties is hierarchical constructed from three nanoscale building blocks of graphene oxide (GO), ZnO nanowires and meal-organic frameworks (MOFs). To assemble the hierarchical nanostructure, one dimensional (1D) ZnO nanowires are firstly well-aligned grown on 2D GO nano-substrate to form a fuzzy-blanket-like nanostructure. The nanoporous ZIF-8 crystals (a subclass of MOFs) are subsequently grown on ZnO surface via a simple chemical vapor deposition (CVD) process. In the obtained nanoarchitectures, GO and ZnO components are two typical active nanomaterials for electrochemical-based biochemical sensors, while nanoporous ZIF-8 crystals material is suitable for biochemical molecules capturing/enriching. Having been tuned into electrochemical sensors, the nano-architectures constructed from GO, ZnO nanowires and ZIF-8 crystals exhibit ultra-high response to dopamine (DA), an important neurotransmitters in the mammalian central nervous system. The limit of detection (LOD) of obtained sensor is estimated as 0.5 nM which is the desired concentration limit for current applications. Furthermore, the integration of different active components shows considerable anti-interference ability towards four typical electroactive coexisting molecules of cysteine, glutathione, ascorbic acid and uric acid which indicates a good selectivity of the developed sensing material.

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Preparation of the natural zeolite based catalyst for hydrocracking process of petroleum derived atmospheric residue

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This research is focused to prepare the natural zeolite based catalysts for hydrocracking and to compare their catalytic reactivity. The clinoptilolite type natural zeolite of Tsagaantsav in Dornogobi province and the paraffinic atmospheric residue of Tamsagbulag crude oil in Dornod province were used in this research. The quality of adsorption or the ion exchange capacity of natural zeolite was improved from 0.21 mmol/g to 0.41 mmol/g after washing and thermal activation of natural zeolite. The Ni or Fe ion was loaded into the zeolite sample which was enriched and calcined previously, by ion exchange method. The prepared Ni/zeolite, Fe/zeolite catalysts were identified by the clinoptilolite type zeolite by database in D500 instrument, which was used in X-ray diffraction analysis. It means the structure of natural zeolite was not broken down during the metal loading. The researchers assigned that the thermal stability of Tsagaantsav zeolite is 950ºC of temperature. Therefore Ni/zeolite, Fe/zeolite catalysts were possible to use in hydrocracking process, which is carried out at 450ºC - 500ºC of temperature. The atmospheric residue (AR) conversion, the contents of sulfur were determined after hydrocracking used the prepared zeolite catalyst, the commercial catalyst and without catalyst. The AR conversion in hydrocracking, with prepared zeolite was used which was 22.5% higher than none catalytic process and 8.9% higher than commercial catalyst. It is proved that both of modified zeolite catalysts worked effectively as a catalyst in hydrocracking of AR. Even so the contents of sulfur in middle and heavy fraction were 490-615 ppm after hydrocracking with Ni/zeolite, Fe/zeolite catalysts. This result was evidenced the Ni/zeolite, Fe/zeolite catalysts were inactive at hydrodesulfurization, because the contents of sulfur in middle and heavy fraction were 370-478 ppm after hydrocracking without catalyst. Therefore there is a need for the sulfur removal process for products after hydrocracking with Ni/zeolite or Fe/zeolite catalysts.

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