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Effect of cobalt doping on the mechanical and structural properties of ZnO nanowires

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Zinc oxide (ZnO) nanostructures have attracted a lot of attention due to the combination of favorable physical properties of ZnO such as being semiconductive, piezoelectric, and biocompatible. At the same time, ZnO is not efficient in the visual part of the spectrum due to its wide band gap (~3.3 eV), which limits the commercial application of these materials as photocatalyst. Transition metal doping has been used to improve the photocatalytic properties of ZnO nanostructures with Co being one of the most efficient dopants. Meanwhile, doping could lead to the deterioration of mechanical properties, which are important for designing devices with predictable and reproducible properties. In the current work we compared the mechanical and structural properties of pure and 5% Co-doped ZnO NWs synthesized by solvothermal method. XRD measurement revealed zincite structure for both samples. HR-SEM and TEM images showed uniform morphology with hexagonal cross section and smooth surfaces for synthesized NWs. Atomic force microscopy (AFM) based 3-point bending and cantilever beam bending inside high resolution scanning electron microscopy (HR-SEM) were used to obtain Young's modulus and bending strength values. We found that mechanical properties for both types of NWs are size dependent and increase with the decrease of diameter. Furthermore, Co-doped ZnO exhibit lower Young's modulus and bending strength values compared to pure ZnO NWs. Lower values can be explained by the introduction of vacancies and defects due to doping with Co.

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Synthesis and characterization of a novel catalyst based on dendrimer of core-POSS and its applications in epoxidation of olefins

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In this research we report the preparation and characterization of a new dendrimer of second-generation with a core of silsesquioxane (POSS-DG2.0). Polyhedral oligomeric silsesquioxanes (POSS), are nanoplatforms with one to eight reactive or nonreactive organofunctional groups (R) anchored to the eight possible vertices of the cubic silsesquioxane. In this nanomaterial was anchored six tungsten organometallic complexes ($[W(CO)_3Br_2(NCMe)_2]$) for application in catalytic epoxidation of olefins. To the best of our knowledge, this study is the first that has reported the preparation of POSS-DG2.0-$[W(CO)_3Br_2]$ for catalytic epoxidation of 1-octene, cyclooctene, (S)-limonene, cis-3-hexen-1-ol, trans-3-hexen-1-ol and styrene. The material was characterized using infrared spectroscopy, elemental analysis, solid-state ^{29}Si and ^{13}C nuclear magnetic resonance and scanning electronic microscope (SEM) coupled to an energy dispersive spectroscopy (EDS). The new organometallic nanomaterial POSS-DG2.0-$[W(CO)_3Br_2]$ was tested as a catalyst in the epoxidation of 1-octene, cyclooctene, (S)-limonene, cis-3-hexen-1-ol, trans-3-hexen-1-ol and styrene. The catalyst behaved as an excellent catalytic precursor for the epoxidation of cyclooctene and styrene using TBHP (tert-butyl hydroperoxide). The material selectively catalyzed the epoxidation for the corresponding epoxides, with and without formation of diols depending on the substrate, with high conversions and TOFs. No reaction took place without a metal containing catalyst.

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