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Superacid Sulfated-Zirconia Mesoporous Carbon (SZrMC) "Efficient Chemotherapeutic Agent"

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Abstract

The goal of this work is the incorporation of zirconium, in the process of self-assembly of the template agents (P123) and hydrolyzed TEOS, and a source of carbon in the original synthesis mixture. This direct incorporation of zirconia leads, after carbonization, to ordered mesoporous carbon material, with zirconium in its structure (SZr-MC), and without zirconium oxide as a bulky species. The sulfated mesoporous carbon has a high acidity that can make the SZr-MC nanoscopic material, with super acidic properties. We have designed a novel synthesis procedure for the formation of acidic mesoporous carbon-based nanomaterials functionalized with sulfated zirconia. During the crystallization process, P123, A-type starch, zirconia and silicon were able to cohesionize. After sulphuric treatments, the physical characteristics of the parent carbon were retained in the ultimate material, revealing a great surface area (1300 m2/g), a large pore volume and a well-ordered porosity composed of uniform mesopores of approximately 3.5 nm. XRD, SEM, TEM and XPS studies indicated the absence of ZrO_2 as a bulk species. Therefore, Zr as an isolated species was successfully anchored in the MC for subsequent sulfation. Furthermore, evidence from the XPS C 1s data can be attributed to the sp2 hybridized carbon (from the graphitic structure of the mesoporous carbon), which would form Zr-C bonds. In addition, the large amount of -OH groups, coming from the starch used as carbon source, would promote the formation of Zr-O-C species (also detected by XPS), forming part of the MC walls, in the self-assembly process.The evidence of two high temperature desorption peaks in the NH3-TPD profile and the high pyridine retention temperature determined by FTIR revealed medium, strong and super-strong acid sites in the SZrMC, and it can be assumed that these sites correspond to a superacid nanomaterial.

Keywords: sulphated zirconia, mesoporous cabon, superacid material, antimicrobial, anticancer, antifungal, nanobiomedical applications.

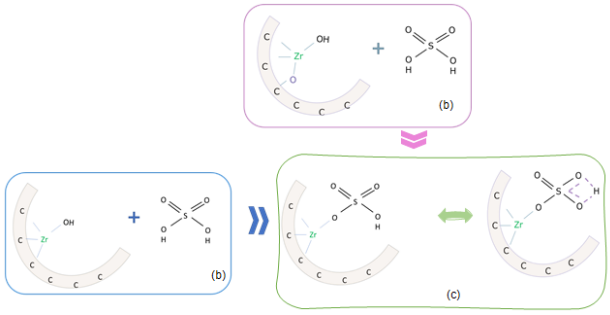

Figure 1: Figure 1 illustrates the two possibilities of interaction between Carbon and Zr, both of which after sulfation lead to the same Superacid Group, influencing conformation, biological activity and functionality, acting as an alkylating agent and killing malignant cells.

References:

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2. Oscar A. Anunziata; Maria L. Martinez Sulfated/Zr-Containing Mesoporous Carbons: A Promising Nanostructured Catalytic Material Journal Of Porous Materials; Año: 2021 in press.