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Peroxides encapsulated in porous silica nanoparticles for application in antimicrobial textiles

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Micro and nanoencapsulated products for controlled delivery are attractive since they are pro-tected against other chemicals until they release the payload. This technology proposes the release of the active product, by entrapment or immobilization in silica nanoparticles of aqueous products, by using a modified sol-gel process, the Stober method. The nanoparticles were tested for the controlled delivery of oxidising products, for possible application on bandages for antimicrobial activity. For application on textile fabrics, the oxidising agents are immobilized by a polymer film applied on the fabric for durability purposes. The nanoparticles we prepared containing hydrogen peroxide, release it at temperatures as low as 15ºC. Release tests were performed. These nanoparticles can also have other aqueous oxidising payloads, such as hypochlorite. In textiles, antibacterial products for hospitals are usually based on triclosan and other leaching biocides. These will soon be banned for causing resistant microbes. Peroxides on the other hand are innocuous and do not cause microbial resistance. For textiles when applied with an antibacterial they will be resistant to washing when applied with polymers that form a protective film over them. Antimicrobial activity was tested on cotton fabric (washed 25 times) treated with hydrogen peroxide nanoparticles. The results showed more than 90% inhibition.

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ZnO nanostructures: Growth processes, structure, resulting properties and applications

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The use of low dimensional structures is a key technological factor in the creation of new functional and sensing devices which benefit from their large surface area to volume ratio. Also, many properties of nanomaterials depend not only on their size but also on their surface state. The properties of nanosized semiconductors are largely determined by surface effects and hence much effort has been directed recently to study and engineer these effects. One of the strategies has been the quest for a proper understanding and control of the relation between nanostructure growth processes, structure, and resulting properties. Among the semiconductors materials, the ZnO is considered an important and promising material. Reasons for this include low-cost, simple and controllable synthesis processes of a wide diversity of nanostructures, such as nanoparticles, nanowires, nanocones, nanostructured films. ZnO nanostructures are subject of increasing interest due to their interesting potential applications in photonics, and chemical and biological sensing. These motives led our research group to develop different techniques for the manufacture of ZnO nanostructures. The production of nanoparticles (precipitation methods), thin films (sol-gel) and nanowires, nanocones (steam technique or electrophoretic deposition) will be detailed. We will also explain the efforts we are making to understand and control the surface processes that mainly affect two aspects: 1) recombination of electrons and holes, and therefore the optical emission and 2) the electrochemical processes. These studies are very important for applications in luminescent emitters (LEDs, lasers) and in the development of amperometric biosensors based on ZnO nanowires or ZnO thin films. Finally, we will discuss photoluminescence, impedance spectroscopy and electroluminescence or electrochemistry in structures and devices of ZnO/MgO, ZnO/PEDOT, and ZnO/GOx (glucose oxidase) nanostructures.

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