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Stability of iron (Fe) nanowires

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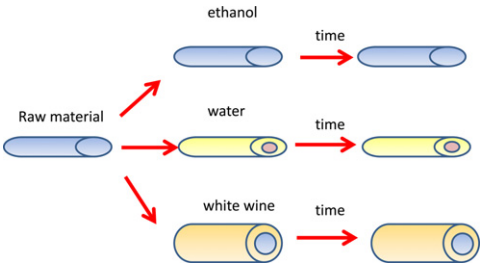
HIGHLIGHTS

- Stability of Fe nanowires in environmental solutions was tested.
- The most aggressive and the least aggressive solutions were determined.
- The influence of different solutions on nanowires core were found out.

GRAPHICAL ABSTRACT



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ABSTRACT

The iron nanowires were obtained by DC electrochemical method in nanoporous anodic alumina templates (AAO). For stability tests these materials were placed in different solutions: white wine, citric acid, 0.9% NaCl, distilled water and ethanol for a 1–3 week time period. The results of such treatment (solubility or possible changes on the surface) of the Fe nanowires were measured by IR (infrared spectroscopy), ASA (atomic absorption spectroscopy), TEM (transmission electron microscopy), XRD (X-ray diffraction) and DSC (differential scanning calorimetry) methods.

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1. Introduction

Nanowires are one of the most important elements in nanotechnology science. They have become interesting for science due to unique density of electronic states caused by small diameters. Based on this fact, different optical, electrical and magnetic properties from their bulk 3D crystalline counterparts are expected [1]. Elongated structures can be obtained by different chemical methods where not uniform growing in one of the three directions is obtained [1]. The other possible and powerful method of nanowires fabrication is electrodeposition, which can be done in structured matrixes such as nanoporous anodic alumina templates (AAO), which provides preparation of magnetic nanowires in large quantities [2]. Such wires can have a tunable diameter from 5–200 nm in respect to the used anodization solution and current parameters. The length of the nanowires can also be from 100 nm to more than 1 μm, depending on alumina thickness. These structures can also be functionalized in further steps by different biomolecules (enzymes, antibodies or nucleic acids) or technological important spices, and treated as novel hybrid systems. Such modifications open the door to a variety of important applications in the areas of nanomedicine and nanobioelectronics [3], IT and technical fields. The scale of applications of the nanoparticles with biomolecules in particular, depends on their size, inner and surface structure, a degree of agglomeration and stability in various solutions. The benefits from nanostructures are significant but describing many physicochemical parameters is extremely important to understand the behavior of nanostructures and their potential toxicity and cellular damage [4,5]. Tremendous number of the applications of nanomaterials and their derivatives causes risk of obtaining the large accumulation of it in some areas of the environment and human body. There is very few studies about circulation of the nanomaterials in human

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