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Applications of nano-structural shape memory alloy for medical devices

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NiTi alloys possessing a shape memory effect and mechanical characteristics similar to the behavior of living tissues have been already used for years as the material for production of medical devices, including implants, for example-stents, without the need for additional devices except catheter-carrier. However, nitinol contains nickel (including on its surface) which is toxic for organism. Different authors give completely different durations and magnitudes of the nickel ion release from microstructural nitinol into the medium, as well as level of biocompatibility and electro-chemical corrosion characteristics. As is well-known that formation of nanostructures is able to afford to give to materials special, controlled characteristics. On the other hand, the high density of inter-granular surface defects could lead to a poor corrosion performance. The purpose of this study is to investigate the composition, structure and properties of polycrystalline nitinol with nano-grains. Nano-structural NiTi (55.91 weight % Ni, 44.03 weight % Ti) wires for production of non-invasive implants (stents) was tested for corrosion resistance under static conditions by dipping into solutions with various acidities (pH from 1.68 to 9.18) for two years, for static mechanical properties and biocompatibility. The structure was determined with the use of the transmission electron microscope (TEM), X-ray diffractometer, scanning electron microscope (SEM) and on the Auger spectrometer. The nickel release is less in comparison with data for microstructural nitinol in a solution of any acidity. A significant retardation of the nickel ion release and the absence of titanium ion release in the weakly acidic and neutral solutions with polished samples are observed. A simultaneous 7-11% increase in strength and plasticity in comparison with microstructural nitinol was attained. Toxicity of samples hasn't been revealed.

Biography

Elena O Nasakina, the authors work is aimed at developing materials for the production of non-invasive implants of medical appointment, such as stent and kava filter, of a self-expandable design aimed at treating cancer and cardiovascular, respiratory, excretory and digestive systems, with an improved complex of operational characteristics, including maximally extended service life, biological inertness, improved mechanical performance, providing the possibility of implants work in the human body under increased loads, better coincidence in geometric parameters with curved parts of the prosthetic organ and minimization of the traumatic effect of the operation due to a reduction in the dimensions in the transport position, a reduction in the cross-section of the mechanism of their delivery to the organ to be restored, the possibility of local therapeutic effect on the damaged site, elimination/reduction of the probability of renewal of the problem being solved.

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