Nanotechnology in medicine/Medical applications of nanofibers

A **nanofiber** is a fiber of any material which diameter is in the order of nanometers. Depending on the production technology , its length can range from tens of micrometers to units of meters. In medicine, it can have a number of applications, both clinical and paraclinical. Examples of such applications are given down below.

Tissue engineering

In tissue engineering, are attempts to use nanofibers for constructing a "scaffold" that would replace the missing extracellular matrix in the newly cultured tissue. The large surfaces and porosity of the matrix created precisely from the nanofibers are advantageously used for this purpose. Strict demands are place on the material used to construct such a matrix. The material must be biodegradeable, but its degradation must not be faster than the own synthesis of the extracellular matrix, the material must be biocompatible, i.e. it must not induce an immune response of the organism, and finally the material must have appropriate mechanical properties. Natural materials such as collagen, chitosan (polysacharide created by deacetylation of chitin), hyaluronic acid, fibroin (protein representing the structural basis of silk), but also synthetic material, usually made on the basis of carbon.

Examination and therapeutic internal organs

Because nanofibers are very thin (their diameter is much smaller than the diameter of a blood capilary), they can be introduced anywhere in the bloodstream. For example, it is possible to introduce a thin bundle of electrically conductive nanowires into the brain, divide it there, and use one nanowire to monitor the electrical activity of only a small group of neurons, or conversely to electrically stimulate this group.

Contamination monitoring

A nanofiber can be constructed from a material that is transparent to light, and therefore obtain an optical fiber with a very small diameter. If dust particles adhere to the surface of such a fiber, the conditions change so much that the light passing through the fiber is scattered. By detecting this scattered light, the contamination can be actually detected very sensitively.

Biomolecular detection

If an optical nanofiber is equipped with a specific detector for a biomacromolecule (e.g. protein), the same phenomenon will occur after binding as when a small impurity settles. This creates a sensitive sensor that reacts to a specific biomolecule.

Links

Literature

- VASITA, R. – KATTI, D. S.. Nanofibers and their applications in tissue engineering. *Int J Nanomedicine.* [online]. 2006, vol. 1, no. 1, p. 15-30, Available from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2426767/?tool=pubmed>. ISSN 1176-9114.

Lecture presentation

- Carmel J. Caruana: Nanotechnologie v medicíně (http://www.med.muni.cz/biofyz/doc/lec-cs/NanotechnologieVMedicine-1h.ppt)
- J.Šrámek: Nanotechnologie v medicíně (2008/09) (http://www.med.muni.cz/~formol/doc/nano-prezentace.pdf)