Comparative mechanical and structural study of TiO_2 nanofibers produced by different methods

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Recently, there has been growing interest in the production of 1D TiO_2 micro and nanostructures using different methods such as facile synthesis, hydrothermal treatment of TiO_2 particles, or sol-gel. One of the simplest and versatile methods of producing TiO_2 nanofibers is electrospinning in combination with sol-gel chemistry, where either needle or needleless electrospinning technique can be used.

Aim of the current study was to synthesise and compare TiO_2 nanofibers produced by needle and needleless electrospinning process. Structural characterization by Raman spectroscopy, SEM and TEM methods revealed similar polycrystalline structure for both types of fibers. Mechanical characterization of nanofibers was carried out using cantilever beam bending test inside SEM. Both Young's modulus and bending strength measurements yielded very similar results for two techniques. Weibull analyse suggests that TiO_2 nanofibers produced by needle electrospinning process are more uniform in microstructure and mechanical behaviour. However, the results of this study show that production of nanofibers can be scaled up to industrial level without significant loss in mechanical properties. At the same time needle method yields in fibers with more predictable properties, which can be important for potential applications of single TiO_2 nanofibers. [1]

[1] M. Vahtrus, A. Šutka, S. Vlassov, A. Šutka, B. Polyakov, R. Saar, L. Dorogin, R. Lõhmus, Mater. Charact. 100, 98-103 (2015)