# Continuous Production of Nanocrystalline $TiO_2$ Nanofibers

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**Titanium dioxide in its anatase allotropic modification is well known for its photovoltaic and photocatalytic activity. Through a modification of Nanospider™ device it was achieved a continuous production of nanocrystaline anatase nanofibers. These inorganic fibres have a huge specific surface area due to their fine diameter and structure and thus offer a promising potential in many applications. In this article it is described the device allowing continuous production of inorganic $TiO_2$ nanofibers by the use of electrospinning process and optimization of following calcination process leading to obtaining of almost pure nanocrystaline anatase structure.**

**Keywords:** Anatase, Electrospinning, Nanofiber, Nanospider™, Photocatalysis, Structure

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## References

[1] JAMIESON, J. C., OLINGER, B. (1968). High-Pressure Polymorphism of Titanium Dioxide. In: *Science*, Vol. 161, No. 3844, pp. 893-895.

[2] DACHILLE, F., SIMONS, P. Y., ROY, R. (1968). Pressure-temperature studies of Anatase, Brookite, Rutile and $TiO_2$-II. In: *The American mineralogist*, Vol. 53, pp. 1929-1939.

[3] FUJISHIMA, A., HONDA, K. (1972). Electrochemical photolysis of water at a semiconductor electrode. In: *Nature*, Vol. 238, No. 5358, pp. 37 – 38.

[4] DING, X. Z., LIU, X. H., HE, Y.Z. (1996). Grain size dependence of anatase-to-rutile structural transformation in gel-derived nanocrystalline titania powders. In: *Journal of Materials Science Letters*, Vol. 15, No. 20, pp. 1789-1791.

[5] HANAOR, D., SORRELL, CH. (2011). Review of the anatase to rutile phase transformation. In: *Journal of Materials Science*, Vol. 46, No. 4, pp. 855-874.

[6] DAVID, L. (2011). *Comprehensive nanoscience and technology*. Elsevier, London.

[7] IBÁÑEZ, J. A., LITTER, M. I., PIZARRO, R. A. (2003). Photocatalytic bactericidal effect of $TiO_2$ on enterobacter clocae, comparative study with other gram (-) bacteria. In: *J. Photochem. Photobiol. A: Chem.*, Vol. 157, pp. 81-85.

[8] MANESS P. Ch. et al. (1999). Bactericidal Activity of Photocatalytic TiO2 Reaction: toward an Understanding of Its Killing Mechanism. In: *Appl. Environ. Microbiol.*, Vol. 65, No. 9, pp. 4094-4098.

[9] RAMAKRISHNA, S. (2005). An introduction to electrospinning and nanofibers. Hackensack, NJ: World Scientific.

[10] LUKAS, D. et al. (2009). Physical principles of electrospinning (Electrospinning as a nano-scale technology of the twenty-first century). In: *Textile Progress*, Vol. 41, No. 2, pp. 59-140.

[11] JIRSÁK O. et al. (2005), CZ Patent, CZ294274 (B6), A, Method of nanofibers production from polymer solution using electrostatic spinning and a device for carrying out the Metod, WO 2005024101.

[12] PETRŮ, M., NOVÁK, O., LEPŠÍK, P. (2012). Increase of the efficiency of the production lines for the spinning of inorganic nanofibers by the electrostatic field intensity optimization. In: *MM Science Journal*, No. 4, pp. 382-385.

[13] KOVÁŘ, R. (2012).Ways to Pull Down Spinning Nanofibersfrom the Rotating Brush in High Voltage Area. In: *53rd International Conference of Machine Design Departments*, Brno, pp. 141- 144.

[14] WETCHAKUN N. et al. (2012). Influence of calcination temperature on anatase to rutile phase transformation in $TiO_2$ nanoparticles synthesized by the modified sol–gel method. In: *Materials Letters*, Vol. 82, pp. 195-198.

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