

Neurite Outgrowth

Neurite Outgrowth is a process wherein developing [neurons](#) produce new projections as they grow in response to guidance cues. Nerve growth factors, or [neurotrophins](#), are one family of such stimuli that regulate neurite growth.

The topological cues of [fibrous scaffolds](#) (in particular [extracellular matrix](#) (ECM)-mimetic nanofibers) have already proven to be a powerful tool for influencing neuronal morphology and behavior. The remote [photothermal treatment](#) provides additional opportunities for neuronal activity regulation. A combination of these approaches can provide “smart” 3D scaffolds for efficient [axon guidance](#) and [neurite growth](#). Antonova et al. proposed two alternative approaches for obtaining [biocompatible photothermal scaffolds](#): [surface coating](#) of [nylon nanofibers](#) with light-to-heat converting nanoparticles and nanoparticle incorporation inside the fibers. They determined the photoconversion [efficiency](#) of fibrous [nanomaterials](#) under near-infrared (NIR) irradiation, as well as [biocompatible photothermal treatment](#) parameters. They also measured photo-induced intracellular heating upon contact of cells with a plasmonic surface. In the absence of NIR stimulation, our fibrous scaffolds with a fiber diameter of 100 nm induced an increase in the proportion of β 3-tubulin positive cells, while thermal stimulation of neuroblastoma cells on nanoparticles-decorated scaffolds enhanced [neurite outgrowth](#) and promoted neuronal maturation. They demonstrated that contact guidance decorated fibers can stimulate directional growth of processes of differentiated neural cells. They studied the impact of nanoparticles on the surface of ECM-mimetic scaffolds on neurite elongation and axonal branching of rat hippocampal neurons, both as topographic cues and as local heat sources. We show that decorating the surface of nanofibers with nanoparticles does not affect the orientation of neurites, but leads to strong branching, an increase in the number of neurites per cell, and neurite elongation, which is independent of NIR stimulation. The effect of photothermal stimulation is most pronounced when cultivating neurons on nanofibers with incorporated nanoparticles, as compared to nanoparticle-coated fibers. The resulting light-to-heat converting 3D [materials](#) can be used as tools for controlled photothermal [neuromodulation](#) and as “smart” materials for [reconstructive neurosurgery](#) ¹⁾.

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Antonova OY, Kochetkova OY, Kanev IL. Light-to-Heat Converting ECM-Mimetic Nanofiber Scaffolds for Neuronal Differentiation and Neurite Outgrowth Guidance. *Nanomaterials* (Basel). 2022 Jun 23;12(13):2166. doi: 10.3390/nano12132166. PMID: 35808000.

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Last update: **2024/06/07 02:52**

