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NANOLIGHT

Photosensitive nanotools for neuronal stimulation and rescue of degenerative blindness

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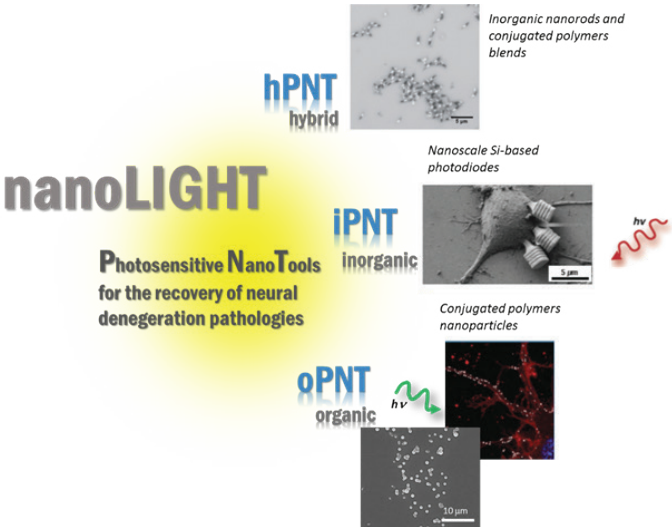

One of the grand challenges of biomedical engineering is to develop methods for interfacing light stimuli with the nervous system. nanoLight will exploit the revolutionary concept of focalized neuronal stimulation without using microelectrodes or planar prosthetic devices and avoiding genetic manipulations. The goal is to compensate for nervous system pathologies in which neuronal degeneration has induced a specific loss of function. This will be obtained by developing novel photosensitive nanotools (PNTs) that, by virtue of their sub-micrometer size, can achieve a spatial discrimination that goes beyond single-cell resolution. PNTs can be delivered to the tissue with minimally invasive microinjections and be anchored to the membranes of target neurons to convert light stimuli into an electrical stimulation. In view of therapeutic applications to human diseases, nanoLight PNTs will target photoreceptor degeneration in Retinitis Pigmentosa (RP) and age-related macular degeneration (AMD). The project will focus on three parallel strategies exploiting both organic and inorganic PNTs: (i) organic PNTs based on conjugated polymers; (ii) inorganic PNTs based on silicon photodiodes; and (iii) hybrid PNTs based on both inorganic semiconductors and conjugated polymers. We were able to previously show that 1st generation PNTs are not endocytosed and preserve their extracellular location in cells and tissue for a long time. Preliminary results indicate that subretinally injected PNTs are effective in rescuing light sensitivity and spatial discrimination in an animal model of RP. This will guide nanoLight biomedical engineering to develop new methods for interfacing optical stimuli with the nervous system for healing pathologies in which neuronal degeneration has induced a specific and irreversible loss of function.