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Presentation Abstract

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Presentation Title:	A polymer-based interface restores light sensitivity in rat blind retinas
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Abstract:	Sight restoration is one of the new frontiers for prosthetic devices that enable the electrical stimulation of neurons. In particular, diseases that affect the retinal pigment epithelium and photoreceptors but preserve the inner retinal layers are preferential targets for implantation of visual prostheses. We discovered that primary neurons can be successfully grown onto a photovoltaic organic polymer and electrically stimulated by light. This result encouraged us to test the efficacy of this method in retinas explanted from albino rats with reproducibly light-induced degeneration of the photoreceptor layer. Acutely dissected retinas were placed on the organic polymer in a sub-retinal configuration (i.e., external layers in contact with the polymer). Light stimulation of the degenerate retina was observed by monitoring multi-unit activity and field potentials with an extracellular electrode positioned in the retinal ganglion cell layer. Multi-unit activity recordings showed that a light stimulus 16-fold lower than the safe limit for pulsed illumination elicited intense spiking activity in degenerate retinas placed on polymer-coated substrates to levels indistinguishable from those recorded in control retinas. Moreover, to evaluate the efficiency of the interface, a dose-response analysis of spiking activity versus light intensity were performed in degenerate retinas.

Spiking activity was observed in degenerate retinas over the polymer with a response threshold below 0.3 μW/mm2, a linear increase in a range corresponding to daylight irradiance, and a response saturation above 100 μW/mm2 (considered the safe limit for chronic illumination). A 4-fold increase in the amplitude of the light response at saturation and a significant left shift of the dose-response curves were obtained in retinas placed over the polymer-coated interface respect to degenerate retinas on glass substrates. Our finding indicates that the interface fully mimics functional photoreceptors in activating the processing of the inner retina and is able to rescue normal light sensitivity. These results broaden the possibility of developing a new generation of fully organic prosthetic devices for sub-retinal implants.
Preliminary results after in-vivo implantation have been already obtained. We demonstrated the long-term tolerability of the organic prosthesis in the eye and its capability to restore light responses monitored by pupillary reflex and visually evoked field potentials in the primary visual cortex.

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Artificial Retina

Neuroprosthesis

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