Researchers restore light sensitivity to retina using polymer-based optoelectronic interface

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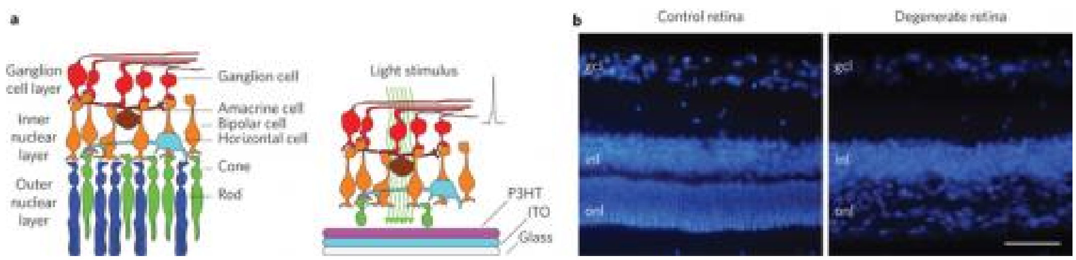

The photoreceptor layer is replaced in the degenerate retina by the organic polymer. Credit: doi:10.1038/nphoton.2013.34

(Phys.org) —A team of researchers in Italy has successfully demonstrated a means for restoring light sensitivity to a damaged rat retina by incorporating an inorganic polymer with nerve cells. In their paper published in the journal *Nature Photonics*, the team describes how they placed a damaged rat retina atop a glass substrate covered with a light sensitive polymer and then found that shining a light on the mix resulted in neural activity similar to that which occurs with a healthy retina.

This new research by the group follows up on research the team conducted two years ago, where they found that they could grow neurons on top of photovoltaic polymers. In this new effort, they placed the polymer poly(3-hexylthiophene) on a small sheet of glass then followed that up by placing a damaged retina extracted from a rat on top of it.

Using the same techniques they'd discovered in their earlier work, they coaxed the cells into incorporating themselves with the polymer. Once that occurred, they shined a light on the result and found that neural activity occurred that was very similar to what happens with retinas that are not damaged.

The polymer used in the experiment is one of a class that is able to convert light into electricity without the need for any other power source. Such materials, the researchers believe, make them ideal candidates for use as a possible means of correcting vision problems in people with retina damage due to diseases such as macular degeneration or retinitis pigmentosa. In these cases, the rods and cones—photoreceptor cells—that make up the retina are damaged or destroyed slowly robbing their victim of sight. The idea with the new research is to see if photovoltaic polymers can be used to replace the damaged nerves, and thus restore vision.

In their experiments the researchers found the retina/polymer combination responded to what they describe as average daylight brightness levels indicting it might prove useful as a means of treating certain types of blindness. They caution however that they also observed that the combined material did not respond to the full range of brightness levels as seen by a healthy eye, though they suggest they believe more research will produce better results. The team next plans to implant their polymer optoelectronic interface into blind rats to see if it can restore vision and if so, how well.

More information: A polymer optoelectronic interface restores light sensitivity in blind rat retinas, *Nature Photonics* (2013) doi:10.1038/nphoton.2013.34

Abstract
Interfacing organic electronics with biological substrates offers new

possibilities for biotechnology by taking advantage of the beneficial properties exhibited by organic conducting polymers. These polymers have been used for cellular interfaces in several applications, including cellular scaffolds, neural probes, biosensors and actuators for drug release. Recently, an organic photovoltaic blend has been used for neuronal stimulation via a photo-excitation process. Here, we document the use of a single-component organic film of poly(3-hexylthiophene) (P3HT) to trigger neuronal firing upon illumination. Moreover, we demonstrate that this bio–organic interface restores light sensitivity in explants of rat retinas with light-induced photoreceptor degeneration. These findings suggest that all-organic devices may play an important future role in subretinal prosthetic implants.

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