Injectable, self-opening, and freestanding retinal prosthesis for fighting blindness made of conjugated polymers

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Fighting blindness with retinal prostheses requires challenges not yet achieved: implanting a prosthesis (i) large enough to cover the retinal surface and (ii) embedding a high number of highly dense stimulatory elements. We developed an injectable, self-opening, and freestanding prosthesis restoring at least 40° of visual field, therefore covering at least a retinal surface of 12 mm in diameter. Moreover, the prosthesis has a hemispherical shape in order to minimize the distance from the targeted cells over its entire surface. It also operates according to a photovoltaic stimulation principle and it should be injected trough a minimal scleral incision. Our implant is based on PDMS as shell material, embedding 2345 organic photovoltaic stimulating pixels made of conjugated polymers (100 μm and 150 μm in diameter, density 54 px/mm^2), with a biomimetic distribution in an active area of 13 mm (44° of visual field). Our results indicate that those pixels can deliver up to 54 mA/cm^2 and generate an electrode potential of 182 mV when illuminated with a pulse light of 10 ms, 32 μW/mm^2, at 530 nm. Accelerated aging tests and experiments with explanted retinas are currently under evaluation. These preliminary results show the potential of organic photovoltaics in the fabrication of a retinal prosthesis with large area and high stimulation efficiency. The biocompatibility and mechanical compliance of the materials represent a step forward in building advanced photovoltaic retinal prostheses.