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A Protein-Based, Ion-Mediated Retinal Implant for the Treatment of Retinal Degenerative Diseases JORDAN GRECO, NICOLE WAGNER, ROBERT BIRGE, University of Connecticut — Impaired vision or loss of sight due to retinal degenerative diseases, including age-related macular degeneration and retinitis pigmentosa, affect over 30 million people worldwide. Because there is no cure for these diseases and treatments only slow the progression, there is a significant need for the development of retinal implants that restore meaningful vision. A number of research groups are creating electrode-based implants to stimulate the damaged retina, however, these implants are low resolution and require external hardware. We describe here a flexible, high-resolution implant that is comprised of the light-activated protein, bacteriorhodopsin. Bacteriorhodopsin is a transmembrane proton pump that converts light energy into chemical energy for its native organism. The protein is a favorable candidate as the photoactive medium in an implant due to a high thermal and photochemical stability and a high quantum efficiency. The implant is fashioned by using layer-by-layer electrostatic adsorption, thereby creating a multilayer film that generates a directional ion gradient. The implant is placed in a subretinal orientation and converts incident light energy into a pH gradient used to activate the bipolar and ganglion cell network. Extracellular recording experiments have revealed that the ion-mediated implant is capable of reproducibly stimulating the degenerated retinas of P23H rats and demonstrate that the relative activation efficiency directly correlates with light intensity.

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