Sensors and Materials, Vol. 24, No. 4 (2012) 205–220
MYU Tokyo

S & M 0880

Fabrication and Evaluation of Silicon Nanowire Photodetectors on Flexible Substrate for Retinal Prosthetic System

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(Received 9 December 2011; accepted 13 February 2012)

Key words: silicon nanowire, photodetector, electrical stimulation, retinal prosthesis

Retinal degenerative diseases result in a progressive degeneration of photoreceptors in the retina and eventually lead to complete blindness. In this study, we develop a novel silicon nanowire photodetector on a flexible substrate to replace the function of photoreceptors on the retina and restore vision for the blind. An extremely high surface-to-volume-ratio characteristic of the nanowire enables the development of highly sensitive photonic sensors. Therefore, a nanowire-based photodetector can be used as a stand-alone retinal stimulation system without an external camera. The fabricated silicon nanowire photodetector is measured to have an average photoresponsivity of 1×10^4 A/W in a wide range of light intensities and wavelengths. Also, the optical characteristics of the silicon nanowire photodetector are well maintained on a flexible substrate, which is verified by comparing the photosensitivity before and after the substrate transfer from a rigid form to a flexible form. To evaluate the mechanical durability of the flexible silicon nanowire photodetector, mechanical bending tests are performed. The optical performance of the flexible photodetector is well preserved during bending for 200 times. The presented performance evaluation results show that the proposed nanowire-based photodetector can be used for the implementation of the retinal prosthetic system. The results of this proposed novel method can point the way to a revolutionary break-through in artificial retina research.

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