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Liquid Crystal Polymer (LCP), an Attractive Substrate for Retinal Implant

Joonsoo Jeong[1,2], Seung Woo Lee[3], Kyou Sik Min[1,2], Soowon Shin[1,2], Sang Beom Jun[4] and Sung June Kim[1,2,*]

[1]Department of Electrical Engineering and Computer Science, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-742, Korea
[2]Inter-University Semiconductor Research Center, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-742, Korea
[3]Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, MA 02114, U.S.A.
[4]Department of Electronics Engineering, Ewha Womans University, 52 Ewhayeodae-gil, Seodaemun-gu, Seoul 120-750, Korea

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Recently, there has been growing interest in liquid crystal polymer (LCP) as a new biomaterial for next-generation implantable neural prosthetic devices. LCP has a very low moisture absorption rate compared with other polymers such as polyimide or parylene-C, providing a superior long-term reliability in the human body. In addition, LCP film is compatible with semiconductor processes, and layer-to-layer lamination is possible simply by fusion bonding of multiple LCP sheets with heat and pressure without the use of adhesives. A monolithic system can be implemented by using LCP as the substrate of electrodes and printed circuit boards as well as packaging material. Therefore, the LCP-based system can achieve a much higher long-term reliability, while maintaining the merits of conventional polymer-based systems such as thinness, flexibility, and simple fabrication procedure. In the present study, we have shown the feasibility of LCP as a substrate and packaging material for a novel monolithic retinal prosthetic device. The patterns of printed circuits and a planar coil were formed on LCP films by thin-film processes, and eye-surface-conformable structure was achieved that enables the attachment of the whole retinal implant on the eyeball. It has been verified that the spherical deformation process did not adversely affect the electrical characteristics or the performance of the printed circuits and the planar coil. The long-term reliability of LCP-encapsulation was evaluated by an *in vitro* accelerated soak test, and possible failure mechanisms were investigated. The LCP-encapsulation could provide reliable electrical insulation for ~400 days in 75°C phosphate-buffered solution (PBS).

*Corresponding author: kimsj@snu.ac.kr