Embedding of Active Components in LCP for Implantable Medical Devices

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Abstract

Liquid Crystal Polymer (LCP) is a thermoplastic polymeric dielectric material which has been shown to be biocompatible.[1,2] Substrates with embedded active components can be fabricated with LCP laminates. By embedding, LCP can be used to "package" bare semiconductor die, and when combined with appropriate patterning and metallization, provide redistribution of the die I/O as well as connections to leads and electrodes. Coils for data communication and near field power transfer can also be included inside the LCP package. Regular die with standard bond pad metallurgy are thinned down to 50 - 100 µm thickness and embedded into LCP substrates. The bond pads are contacted with plated vias to the metal layers inside the multi-layer LCP substrate. The total package thickness is less than 250 µm which is suitable for implants directly under the skin. Possible applications range from neurostimulation including electrodes for deep brain stimulation and various sensor-based monitoring devices.

In order to demonstrate potential for attaining the biostability required for medical implant applications, soak testing of the LCP package was performed. Results from long term soak tests of embedded die LCP packages in buffered phosphate saline (PBS) at elevated temperature are discussed. The results of this testing indicate the effectiveness of LCP for producing a hermetic packaging solution for active components under such conditions, thus demonstrating the potential for such packages to be permanently implanted in the human body.

References:

[1] J. Jeung, et al., "A novel multilayered planar coil based on biocompatible liquid crystal polymer for chronic pain implantation," Sensors and Actuators A: Physical, Volume 197, 1 August 2013, pp. 38-46. [2] S.W. Lee, et al., "Development of Microelectrode Arrays for Artificial Retinal Implants Using Liquid Crystal Polymers," IOVS, December 2009, Vol. 50, No. 12, pp. 5859-5866.