Liquid Crystal Polymer Substrates to Enable Advanced RF and Medical Applications

Susan Bagen – Micro Systems Technologies, Inc., 1839 S. Alma School Road,

Suite 270, Mesa, AZ 85210-3024 USA Ph: 972-839-7465

Eckardt Bihler*, Marc Hauer*, Daniel Schulze* – *Dyconex AG, an MST company,

Grindelstrasse 40, CH-8303 Bassersdorf, Switzerland www.mst.com/dyconex

E-Mail: susan.bagen@mst.com

Abstract

Liquid Crystal Polymer (LCP) has unique properties as compared to conventional dielectric materials, which enable its use for a range of advanced applications including RF microwave and implantable medical devices. LCP is lightweight as compared to ceramic materials, and has superior and stable electrical and mechanical characteristics across very high frequencies up to 100 GHz. Due to the very low water absorption of LCP, these properties remain nearly constant upon exposure to moisture, classifying the material as near-hermetic.[1.2] LCP is highly chemically inert, and biocompatible for direct implant into the human body.[3] While most conventional dielectric materials are thermosets, LCP is a thermoplastic which poses challenges to producing complex multilayer substrates and unique structures such as cavities and long leads. A thorough understanding of LCP material behavior under lamination processing conditions is critical to fabrication of reliable substrates. In addition, for long-term implantable medical applications, noble metal conductors must be used in lieu of potentially toxic copper and nickel, while knowledge of appropriate processing chemistries is necessary to assure biocompatibility of the final product.

This paper will present results of advanced LCP processing development to establish fabrication capabilities of complex substrates for RF microwave applications as well as structures for directly implantable medical technologies. Examples of RF substrate designs are complex multilayer stackups that include cavity structures for bonding of high power die directly to heat sink materials. Multilayer structures of LCP with noble metal conductors for biocompatible medical implants are also discussed.

References:

[1] A. Pham, *"Liquid Crystal Polymer for Microwave and Millimeter-wave Multilayer Packages and Modules,"* IEEE Microwave Conference (EuMC), Paris, France, September 2010, p. 352.

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[3] D. Schulze and R. Toelke, "Noble Metal PCB Manufacturing for Direct Implants," The PCB Magazine, November 2014, pp. 12-20.