Sensor Technology Integration and Hermetic Module Fabrication Using Liquid Crystal Polymer

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Abstract

Innovative methods of integrating thin film manufacturing technologies known from the semiconductor industry into standard flexible substrate fabrication methods have been developed. Sputtered materials can be combined with standard copper traces to produce resistors, thermistors and thermocouples on flexible liquid crystal polymer (LCP) dielectric. These structures can be utilized for high precision temperature sensing, with thermistors providing an absolute temperature reading, while thermocouples can measure temperature differences. For example, a constantan / copper transition can measure temperature differences with a thermoelectric coefficient of 42 µV/K. Silicon sensor die, such as MEMS pressure sensors, laser-diodes or photo-diodes, can be embedded into LCP flex with cavity window openings in order to let the medium access the sensor surface. Hermetic sensor modules can also be constructed using LCP, which is a chemically and biologically stable thermoplastic polymer, having very low moisture absorption comparable to inorganic encapsulation materials such as glass. Significant miniaturization can be achieved by either embedding die into LCP flex, or utilizing LCP as a housing over standard surface mount technology (SMT) assembled components. Multilayer LCP films can be used both for the substrate and as the material for the module housing. This presentation will discuss details of the fabrication technology, examples of various module configurations including 3D forms, as well as reliability test results from extensive soak testing.