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Low-Complex, High-Fidelity Two-Grades Cyclo-Olefin Copolymer (COC) Based Thermal Bonding Technique for Sealing a Thermoplastic Microfluidic Biosensor

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Abstract : The development of microfluidic-based biosensors over the last years has shown an increasing employ of thermoplastic polymers as constitutive material. Their low-cost production, high replication fidelity, biocompatibility and optical-mechanical properties are sought after for the implementation of disposable albeit functional lab-on-chip solutions. Among the range of thermoplastic materials on use, the Cyclo-Olefin Copolymer (COC) stands out due to its optical transparency, which makes it a frequent choice as manufacturing material for fluorescence-based biosensors. Moreover, several processing techniques to complete a closed COC microfluidic biosensor have been discussed in the literature. The reported techniques differ however in their implementation, and therefore potentially add more or less complexity when using it in a mass production process. This work introduces and reports results on the application of a purely thermal bonding process between COC substrates, which were produced by the hot-embossing process, and COC foils containing screen-printed circuits. The proposed procedure takes advantage of the transition temperature difference between two COC grades foils to accomplish the sealing of the microfluidic channels. Patterned heat injection to the COC foil through the COC substrate is applied, resulting in consistent channel geometry uniformity. Measurements on bond strength and bursting pressure are shown, suggesting that this purely thermal bonding process potentially renders a technique which can be easily adapted into the thermoplastic microfluidic chip production workflow, while enables a low-cost as well as high-quality COC biosensor manufacturing process.

Keywords : biosensor, cyclo-olefin copolymer, hot embossing, thermal bonding, thermoplastics
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