Evaluation of Methods for Embossing Micro-Features in Thermoplastics

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During the last few decades the use MEMS (Micro-Electro-Mechanical-Systems) has been steadily increasing in a number of industries, and especially in the medical industry. One application for MEMS is in micro-fluidic devices that rely on micro-channels (10 to 200 μm wide and deep) to direct and analyze fluids for medical diagnostics. Current methods, including hot embossing and micro-injection molding, are slow (1 to 10 minutes cycle time) and expensive. Batch and continuous embossing methods have the potential of producing micro-channels rapidly and inexpensively. Four surface heating methods were studied: infrared radiation (IR) heating, hot gas heating, heated tool, and ultrasonic heating. For IR and hot gas heating, a cold tool with the features was pressed onto the surface immediately following heating. For hot tool heating and embossing, the micro-features were machined on the surface of the heated tool. Similarly, for ultrasonic embossing the micro-features were machined on the surface if the horn. It was found that cycle times as short as a few seconds were achieved and the quality of the features was similar to those seen in injection molding.