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**PVD-based thin film temperature sensors for hot embossing and injection molding processes**

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The cost-effective fabrication and precise replication of high-quality plastic components, e.g. microoptics, requires quick measurement and exact control of the interfacial temperature between polymer melt and forming tool surface: On the one hand, the interfacial temperature has to be adjusted close to the glass transition temperature of the polymer in order to reach good replication grades. On the other hand, higher temperatures lead to increased sticking tendencies and increased demolding forces. State of the art temperature sensors are positioned at some distance from the mold surface and are too slow to detect sudden changes in interface temperature during injection of the polymer. For this reason, there is a growing demand for in-process methods to detect quick changes in surface temperatures. We present our works on PVD-based thin film temperature sensors which make use of the well-known Seebeck-effect and may be deposited directly on the surface of molding tools. In order to investigate their performance in hot forming processes, we built an experimental setup to simultaneously measure adhesive strengths between tool and polymeric melt during hot-embossing as well as the ‘real’ interfacial temperature. For the hot embossing experiments Ni/NiCr-thin film thermocouples were deposited on test tool surfaces by ion-beam assisted deposition and protected by an antiadhesive, organic topcoat deposited by CVD. The steel tools were heated and embossed into molten PMMA. The contact behaviour of PMMA-melts with coated and uncoated steel surfaces was compared and the influence of the tool’s coating on heat flow was investigated. The experimental results were corroborated by numerical calculations where the often neglected heat-transfer coefficient between tool and coating was explicitly taken into account. Our results indicate that PVD-based temperature sensors might be useful to measure ‘real’ interface temperatures, thus enabling users to optimize process parameters.

**Keywords**

thin film thermocouple
thermomechanical stability
adhesion