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Embedded thin-film thermocouples for self-sensing composite materials

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A composite material is a heterogeneous material which consists of clearly distinguishable phases, often referred to as the reinforcement and the matrix. The purpose of a composite is to combine the properties of its constituting building blocks in order to obtain a material with enhanced properties. Fibre-reinforced polymer-matrix composites enjoy the reputation of having high specific stiffness and strength compared to metals, as well as good resistance against corrosion and fatigue. Therefore, these materials are very attractive for lightweight applications such as aeronautics, space applications, transport, automotive sector, sports and recreation. Structural components with high-quality demands are often produced by autoclave-assisted, as well as out-of-autoclave curing. The quality of the final composite component is strongly influenced by the conditions of the autoclave cycle, i.e. cure time, pressure and temperature. To assure optimal quality of the composite part, there is a growing demand for sensors that are capable of in-situ monitoring of the curing process during the autoclave cycle.
Thin-film thermocouples (TFTC) are a promising candidates to fulfill in-situ temperature sensing. Unlike more conventional fibre-, foil- or micro-sensors causing material and geometrical discontinuities when embedded in the composite material, TFTC's can be embedded without major impact on the composite's structural life, integrity and mechanical properties. Furthermore TFTC's have negligible mass, a high degree of geometrical freedom and minimal gas flow disturbance when applied on a surface. In this work, the feasibility of self-sensing composites based on embedded TFTC's deposited by magnetron sputtering is explored. In a later stage, the development of other thin-film sensors will enrich the self-sensing capability of fibre-reinforced polymeric composites.

Keywords
self-sensing
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