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Embedded Gold Nanorods as Microscale Thermochromic Temperature Sensors W. JOSHUA KENNEDY, KEITH SLINKER, Universal Technology Corporation, Air Force Research Laboratory (WPAFB), HILMAR KOERNER, GREGORY EHLERT, JEFFERY BAUR[1], Air Force Research Laboratory (WPAFB) — Gold nanorods (AuNRs) are known to undergo a shape transformation via surface melting at temperatures far below the bulk melting temperature of gold. Because the optical scattering by the AuNRs depends on both particle morphology and the surrounding local dielectric constant the opto-thermal properties of polymer-AuNR nanocomposites depend strongly on the chemical and mechanical characteristics of the polymer host. We have measured the optical absorption of polymer nanocomposites consisting of AuNRs in a variety of polymer systems as a function of temperature, time, molecular weight, and crosslink density. Our results show that the shape transformation of the AuNRs is not well described by a simple kinetic model, and that multiple contributors to the surface energy play significant roles in the process. We show that the dynamics of the shape transformation may be calibrated in a nanocomposite such that the optical absorption spectrum of the material may be used as a local sensor of both temperature history and degree of cure. We demonstrate the usefulness of this technique by measuring (ex situ) the temperature of an internally heated epoxy resin with a lateral spatial resolution of < 10 μm.

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