

Photothermal Quantum Dot Fluorescence-Based Thermometry for Thermal Property Determination of Thin Fibers

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Thermal characterization of micro/nano-size fibers has been developed based on contact and non-contact methods, with one of the major drawbacks of contact methods being the uncertainty that is introduced by thermal contact resistance when fitting theoretical models to experimental data. Being non-contact, photothermal methods can eliminate this concern. In this work, the feasibility of photothermal fluorescence-based thermometry to determine the thermal diffusivity of thin fibers is investigated. The fluorescent spectra of CdSe ZnS core-shell quantum dots deposited onto a synthetic spider silk fiber were recorded at calibrated temperatures. An artificial neural network was trained based on different features of these calibrated spectra, with the intent on reproducing surface temperature oscillations of the fiber during sinusoidally modulated illumination by a laser. By means of the artificial neural network, both the absolute surface temperature and complex temperature variations were used to extract the thermal properties of the fiber from the axial distance and frequency dependence of the signal.