

Temperature-Sensitive Paint

High resolution non-intrusive measurements of temperature and heat transfer using temperature sensitive paint have been demonstrated by several researchers^{1 2}. A typical TSP consists of the luminescent molecule and an oxygen impermeable binder. The basis of the temperature sensitive paint method is the sensitivity of the luminescent molecules to their thermal environment. The luminescent molecule is placed in an excited state by absorption of a photon. The excited molecule deactivates through the emission of a photon. A rise in temperature of the luminescent molecule will increase the probability that the molecule will return to the ground state by a radiationless process, this is known as thermal quenching. The temperature of the painted surface can be measured by detecting the fluorescence intensity of the luminescent paint.

The luminescent intensity of the temperature sensitive paint at a given point is not only a function of temperature. For practical applications of TSP spatial variations in illumination, probe concentration, paint layer thickness, and camera sensitivity will result in a variation in the detected luminescent intensity from the test surface. These spatial variations are eliminated by taking the ratio of the luminescent intensity of the paint at the unknown test condition (*wind off*) with the luminescent intensity of the paint at a known reference condition (*wind on*). This is identical to the procedure utilized for pressure-sensitive paints. The experimental setup for temperature-sensitive paints is similar to that for pressure-sensitive paints and is shown in Figure 1. A calibration of typical temperature-sensitive paint is shown in Figure 2.

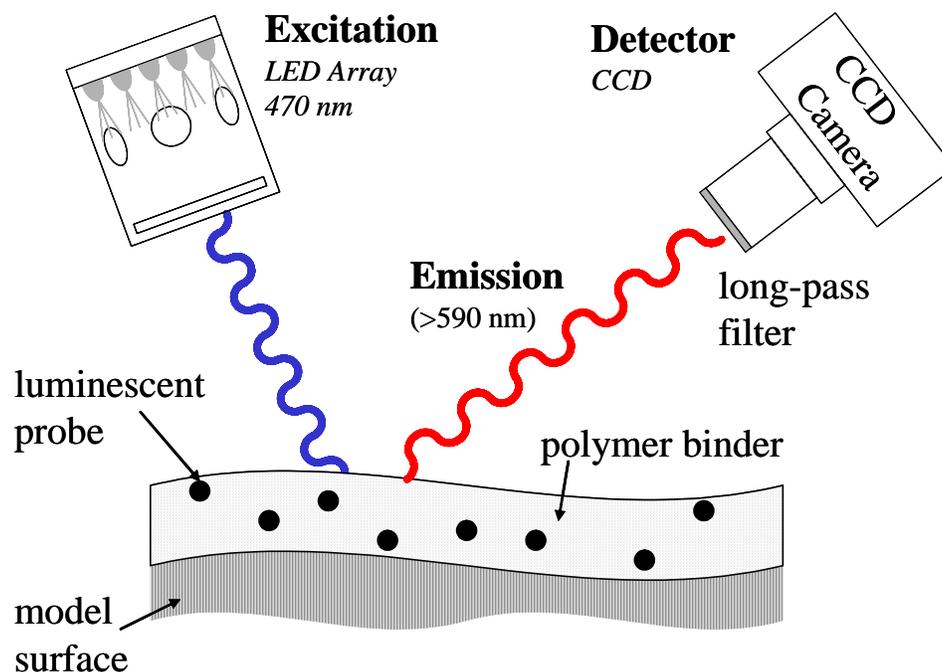


Figure 1 Basic Temperature-Sensitive Paint system.

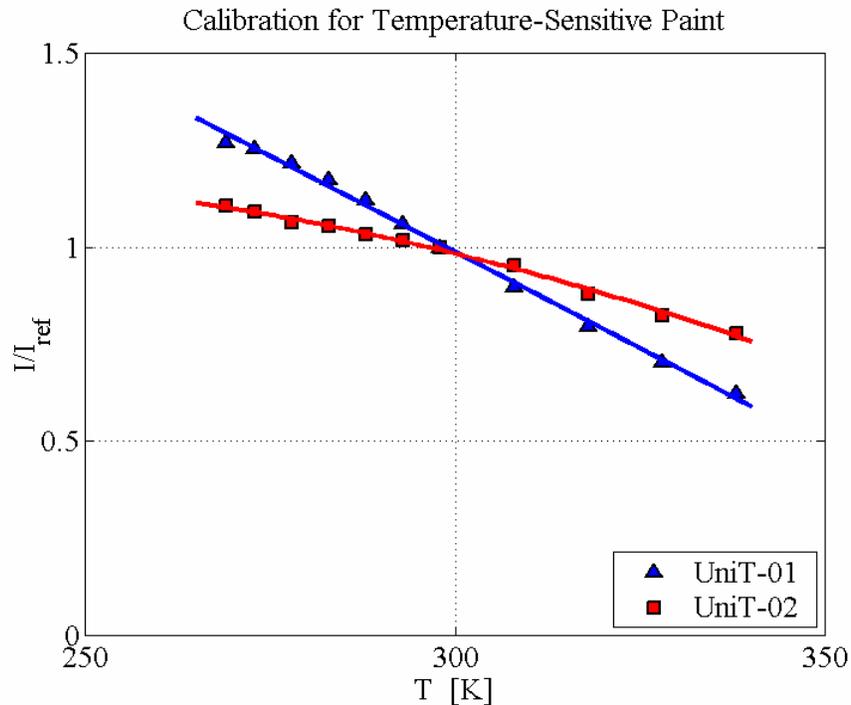


Figure 2 ISSI UniTemp. Simple application and storage (shipped in a spray paint can) and long shelf life. Exhibits good temperature sensitivity (1% per K) and is not sensitive to pressure. Broad excitation spectrum (400-nm to 520-nm) Range of operation 280 K to 370 K.

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References

¹ T. Liu, B.T. Campbell, S.P. Burns, J.P. Sullivan, "Temperature- and Pressure-Sensitive Luminescent Paints in Aerodynamics", Applied Mechanics Reviews, vol. 50, pp.227-246, (1997)
² K. Navarra, D. Rabe, S. Fonov, L. Goss, C. Hah, "The Application of Pressure and Temperature Sensitive Paints to an Advanced Compressor", Journal of Turbomachinery, vol. 123, n 4, pp. 823-829, (2001)