

## Light Thermal Damage in Polymer Composite Systems: Analysis of Bulk and Surface Properties through Vibrational and X-Ray Spectroscopy

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Polymer composite materials have shown significant advances in the replacement of metals as structural materials in military applications. While these materials are lighter and stronger, they are also substantially more susceptible to degradation from conditions where metals are unperturbed. In addition to ultraviolet radiation[1], exposure to service temperatures above  $T_g$  but below the point of burning[2] can lead to premature material failure. In this work, we explore the effects of this “light” thermal damage on the bulk properties of a carbon fiber / vinyl ester composite, and examine the changes in surface oxidation and other modes of decomposition, in the hopes of better understanding the bulk changes. Laser-induced fluorescence has been used to detect thermal exposure, and has been related to changes in mechanical properties of the composite. The surfaces of both the composite and neat resin have been studied with Raman, FTIR, and X-ray spectroscopic methods in order to detect surface and near-surface changes in chemistry. Common trends in changes of properties with increasing exposure will be discussed.

### References:

- [1] A.W. Signor, M.R. VanLandingham, J.W. Chin, *Polymer Degradation and Stability*, 79 (2002) 359-368.
- [2] P. Kulowitch, W.R. Scott, *Nondestructive Characterization of Materials XI*, Proceedings of the International Symposium, 11th, Berlin, Germany, June 24-28, 2002, (2003) 545-553.