Proposed Research on

Aging Degradation in Polymeric Composites

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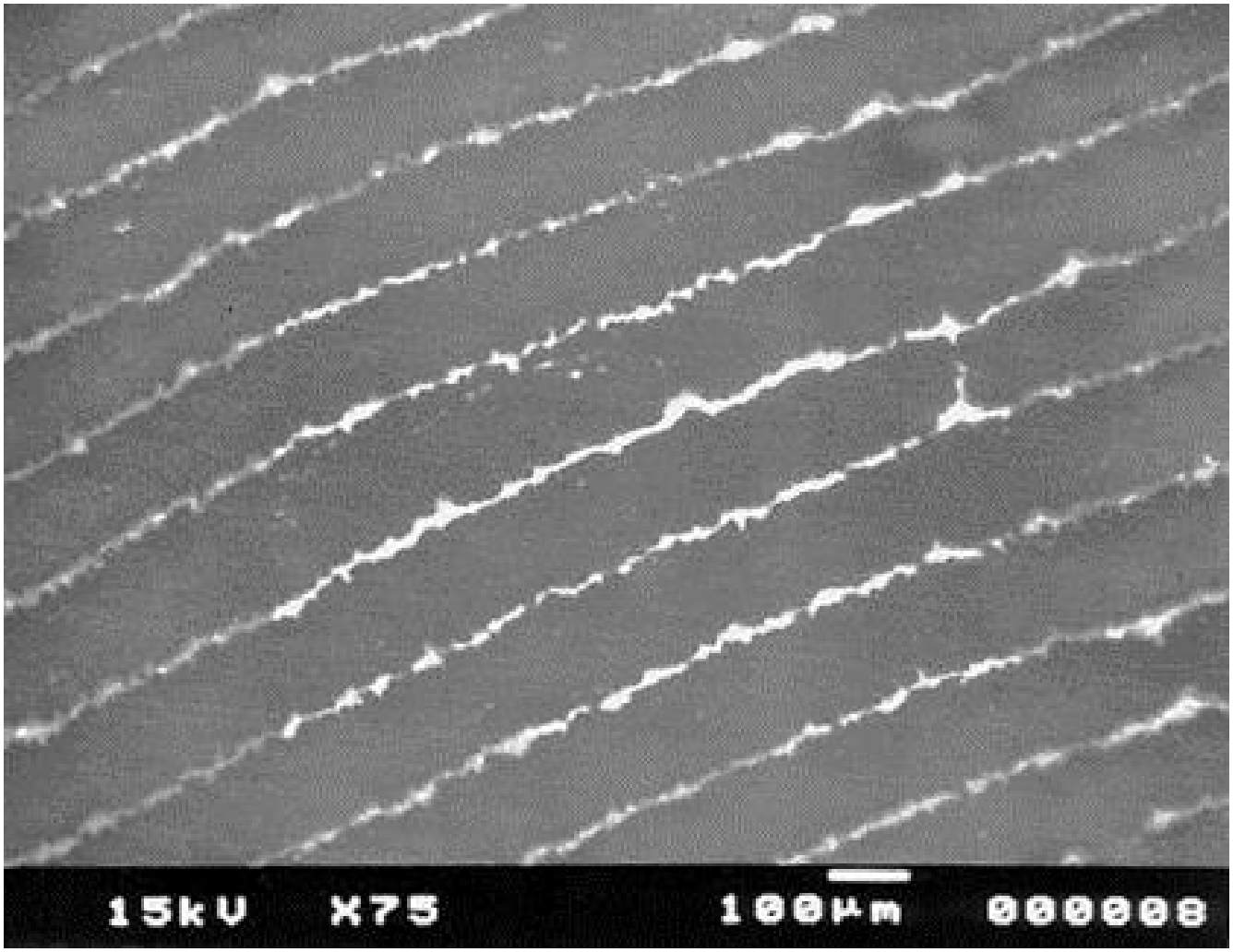
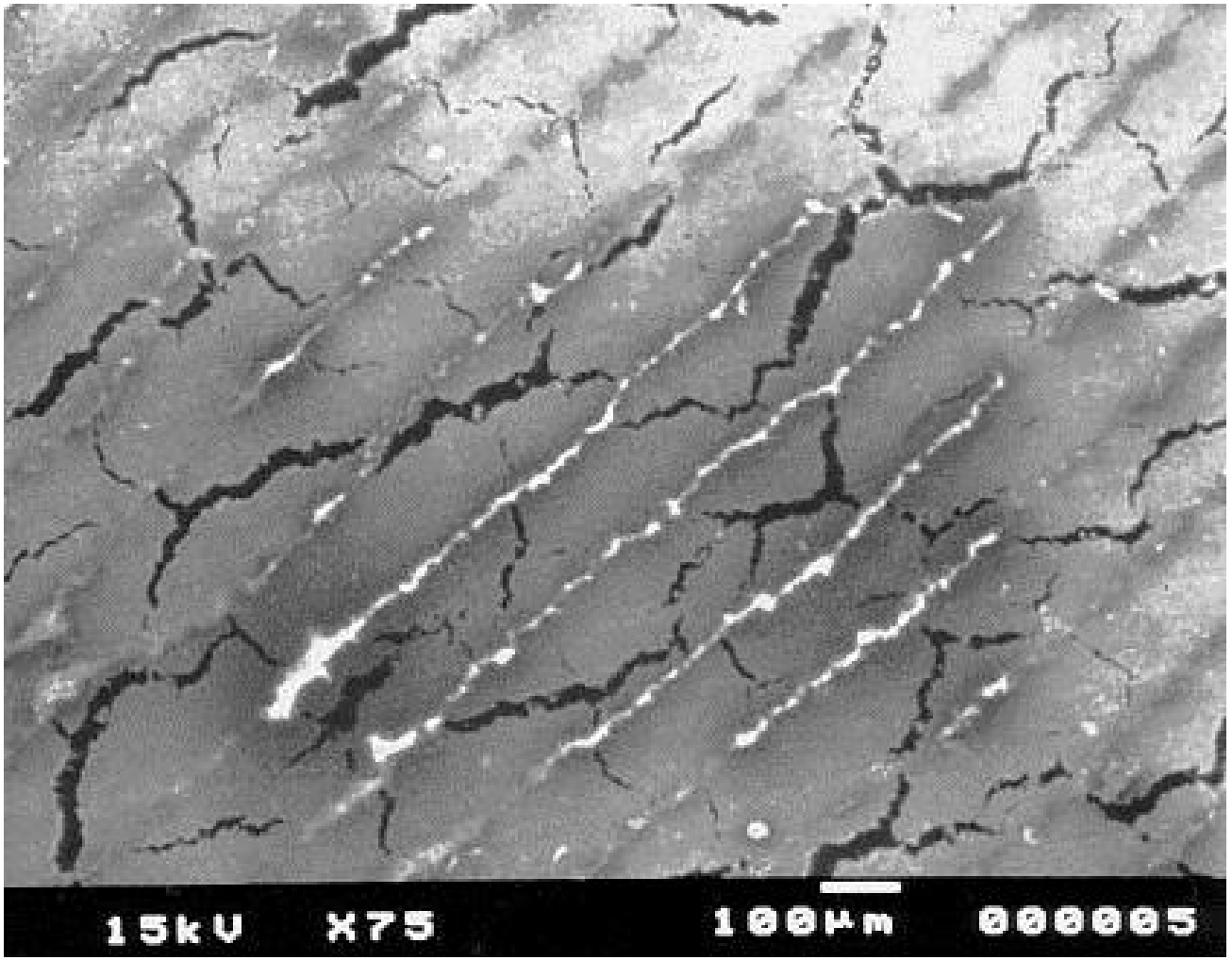
Previous Research Highlights (Lin et al, 1994- 2003)

- Discoloration due to oxidation occurs in CFRP when exposed to elevated temperatures
- An experimental method using the XPS with a differential charging technique was developed to measure chemical composition in the discolored region
- Compression-after-impact (CAI) strengths were found to decrease with increasing aging time and temperature
- A finite element method was developed to predict time-dependent oxidation process in polymeric composites

Unaged Unidirectional IM7/5260 Specimen At Free Edge

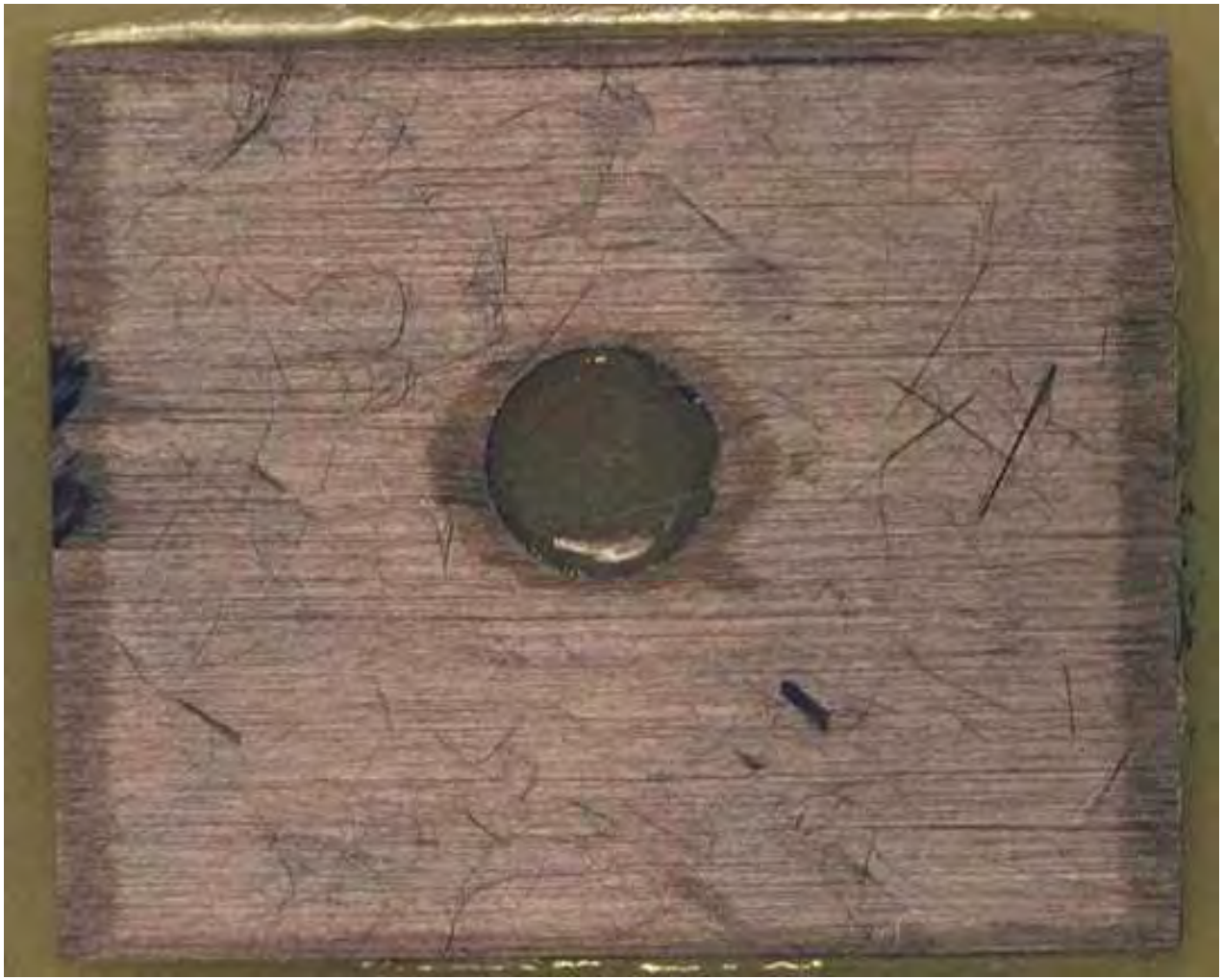


Aged Unidirectional IM7/5260 Specimen 400°F, 4 months



Discolored region in IM7/5260 specimen

0 ply, 350°F, 13 months

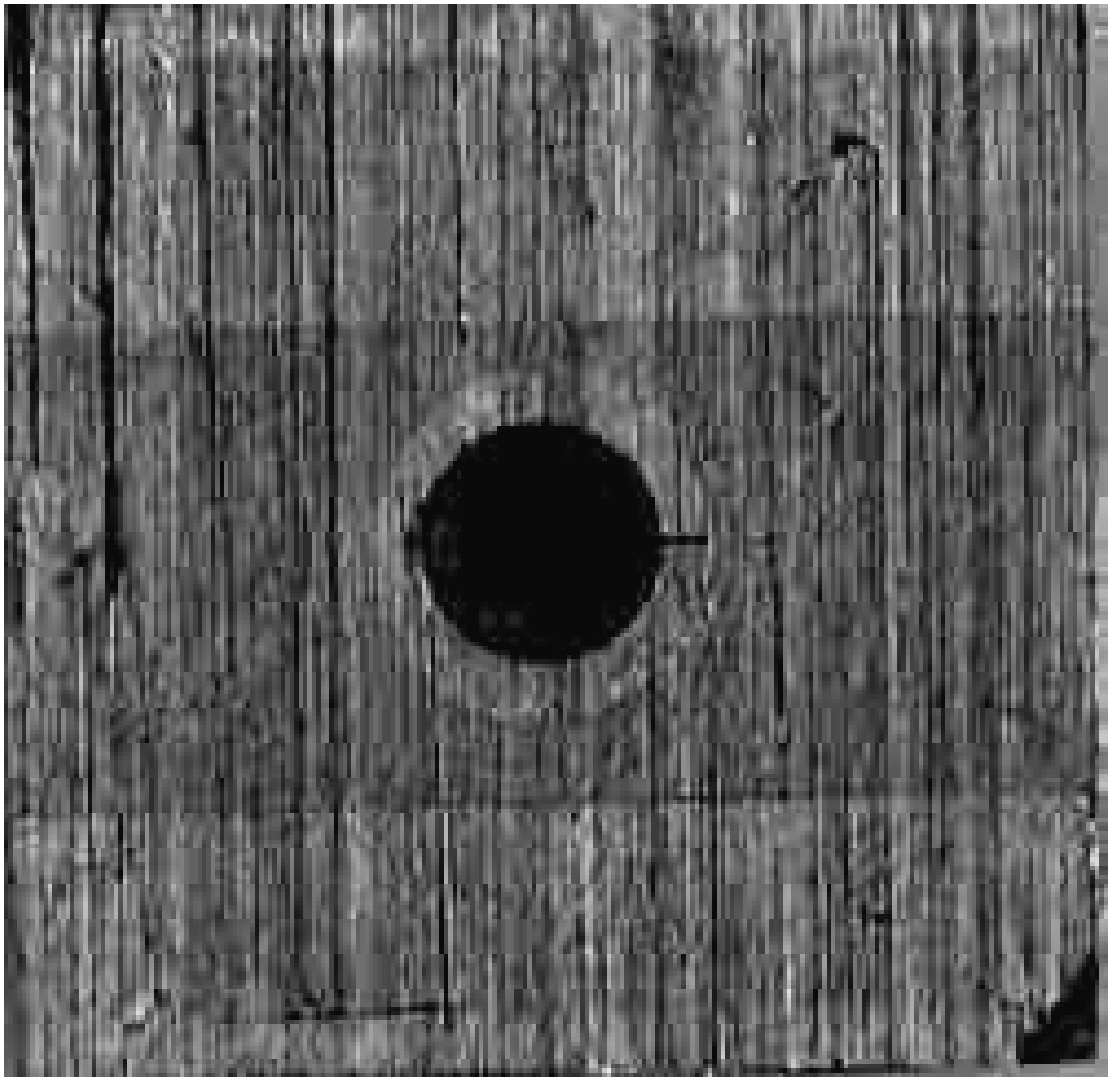


Discolored Region in IM7/5260 Specimen 45 ply, 350°F, 13 months

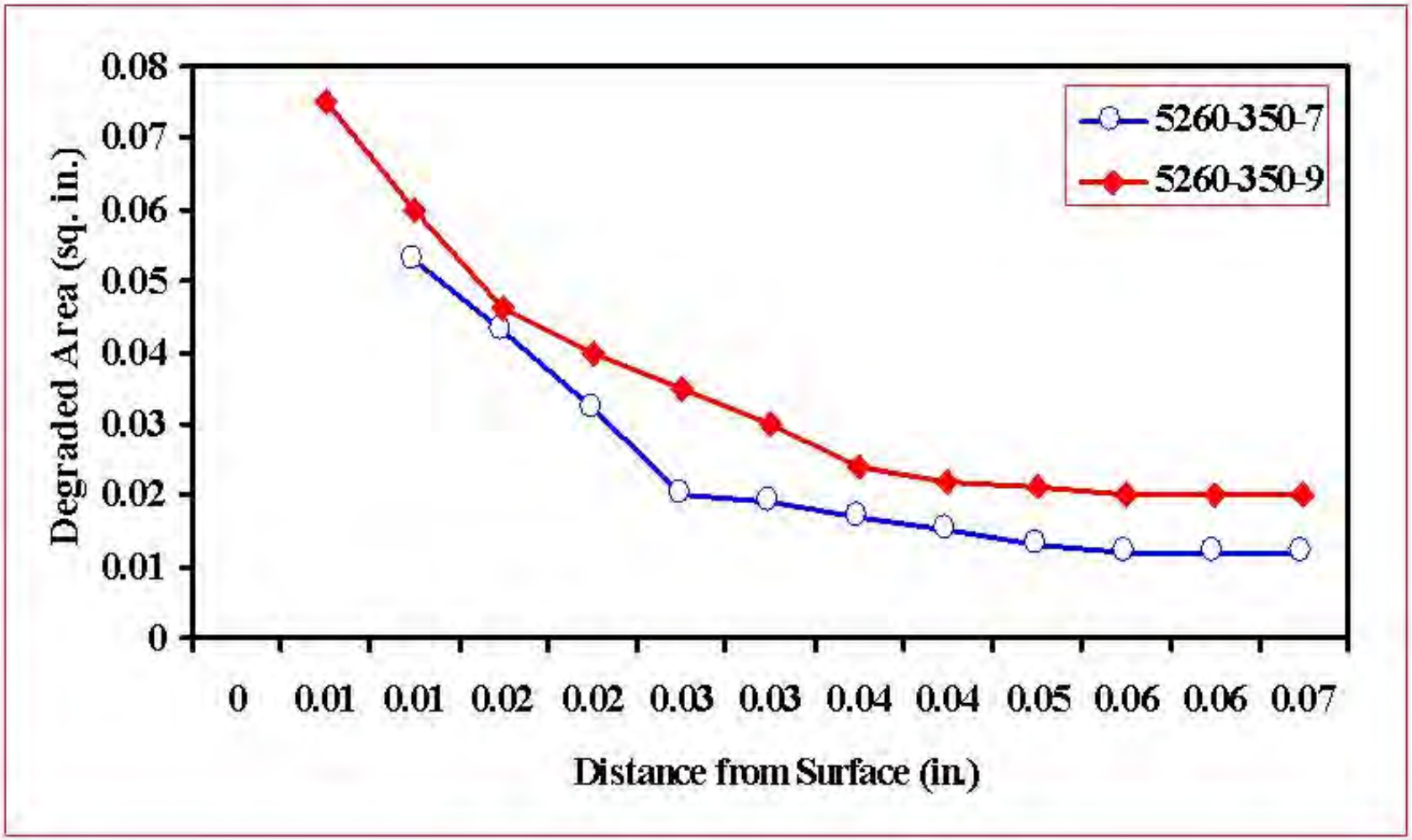
Discolored region in IM7/5260 Specimen 90 ply, 350°F, 13 months

Discolored Region in IM7/K3B Specimen
0 ply, 350°F, 13 months

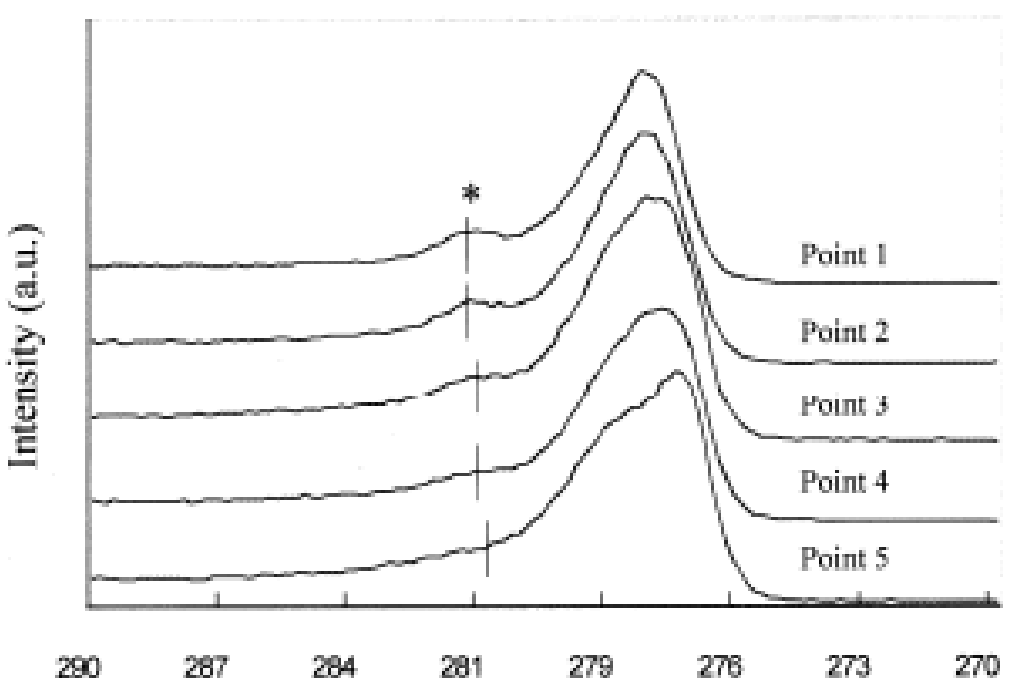
Discolored Region in IM7/K3B Specimen 90 ply, 350°F, 13 months

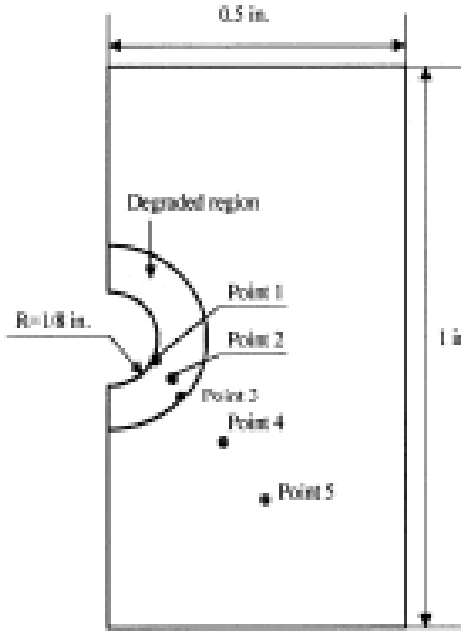


Degraded Area in Aged IM7/5260 Quasi-Isotropic Open Hole Specimen (400°F)



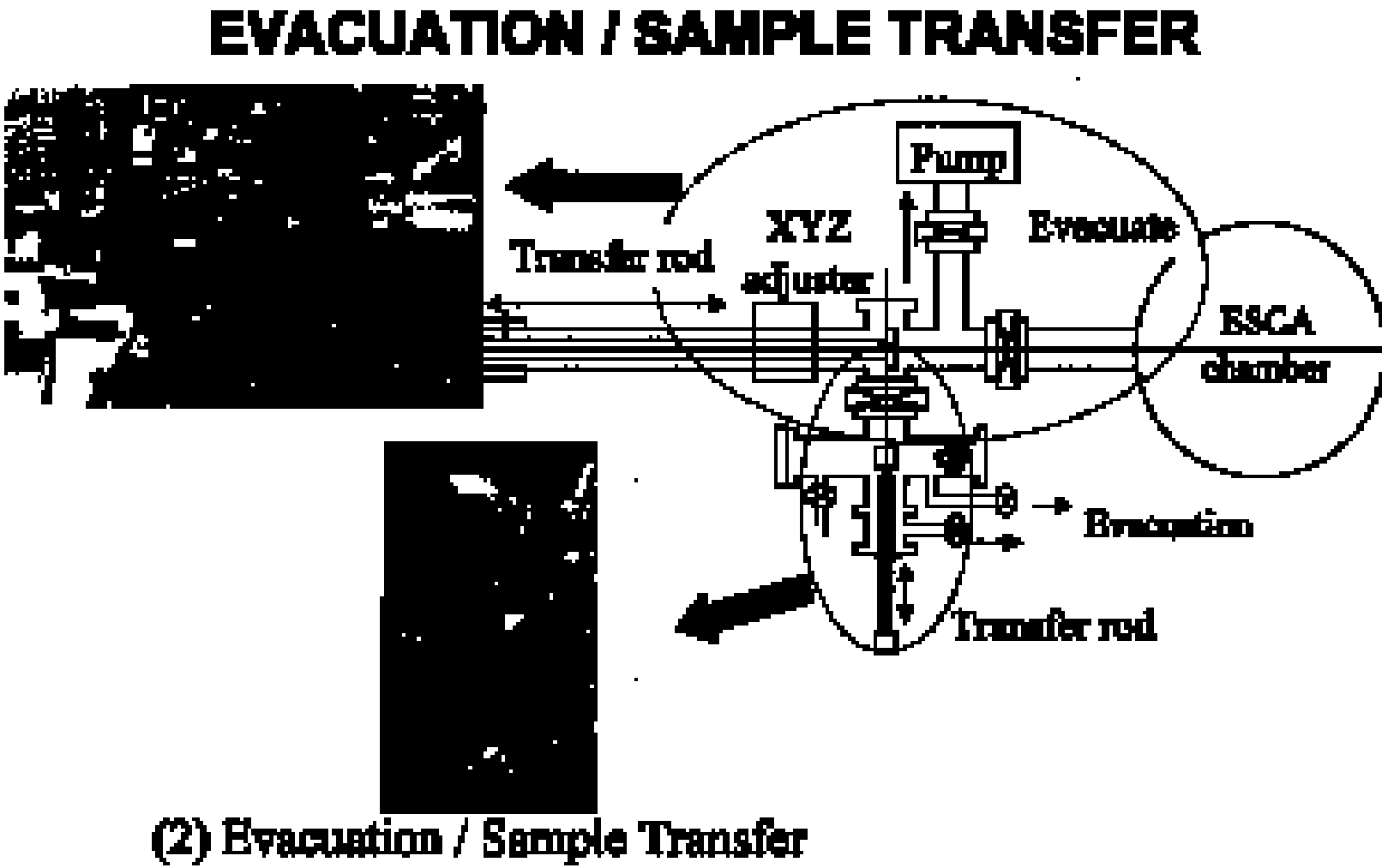
XPS Measurement of Oxygen Composition



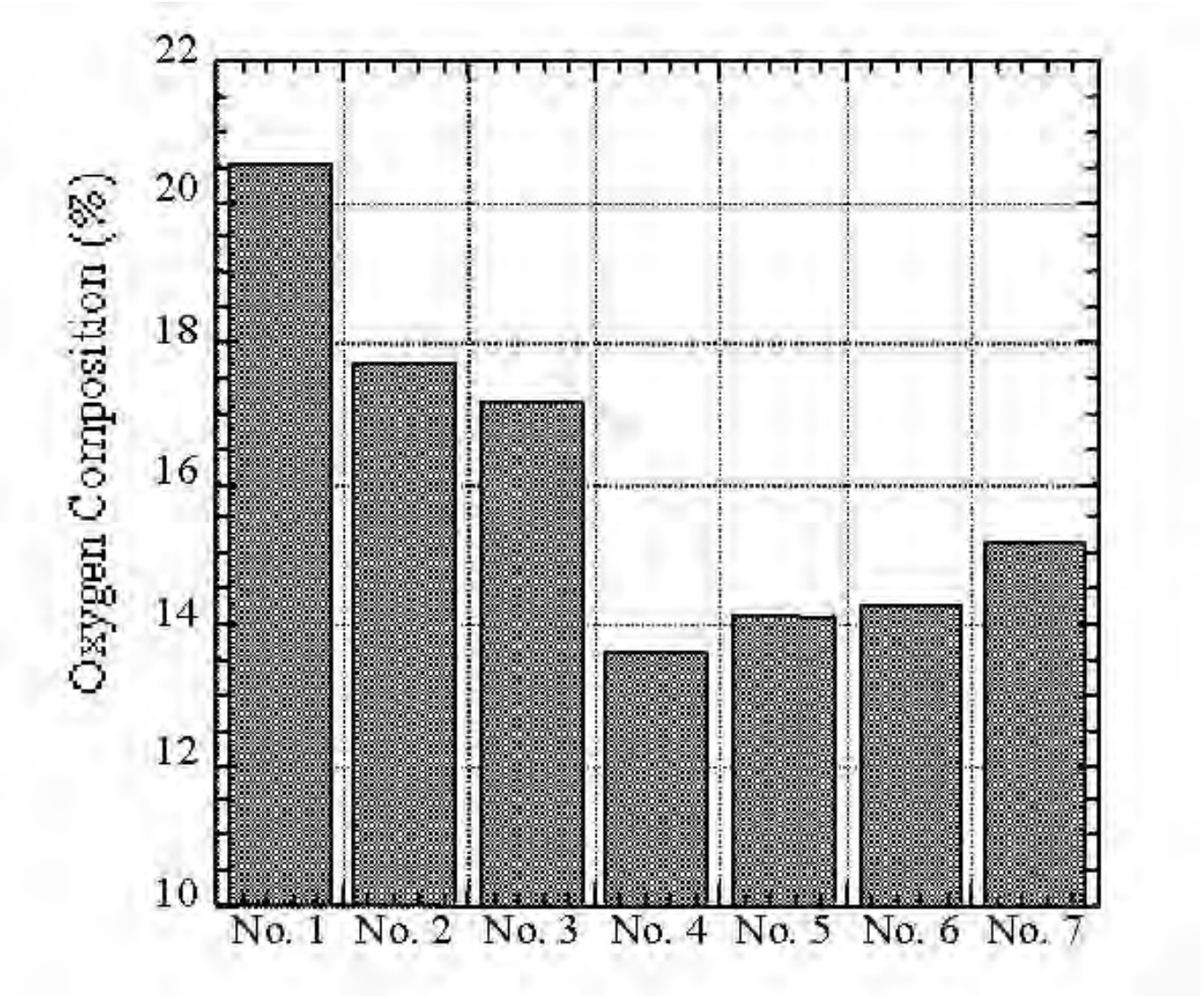


IM7/5260 aged for 5,000 hours at 400°F

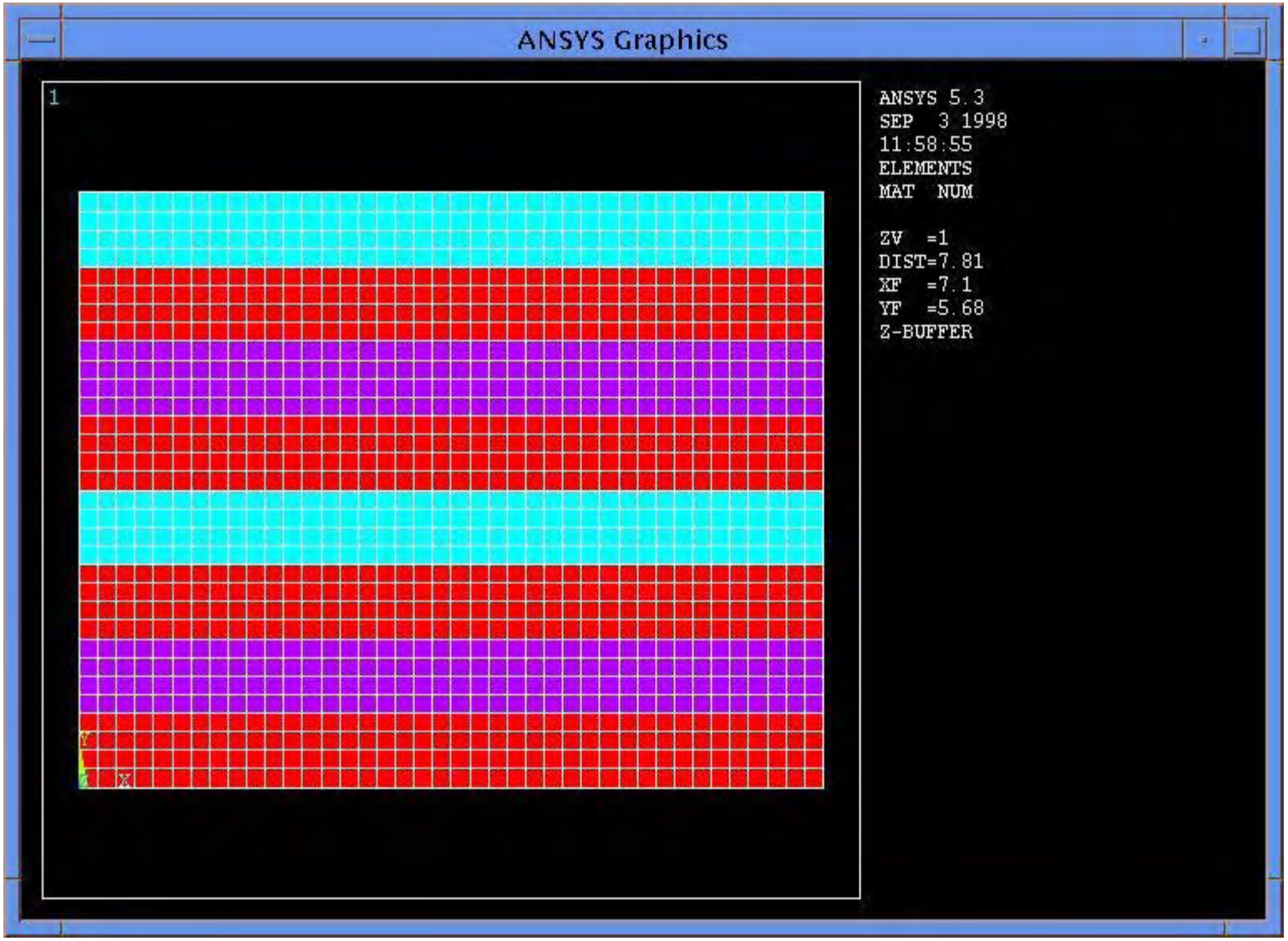
XPS Experimental Setup



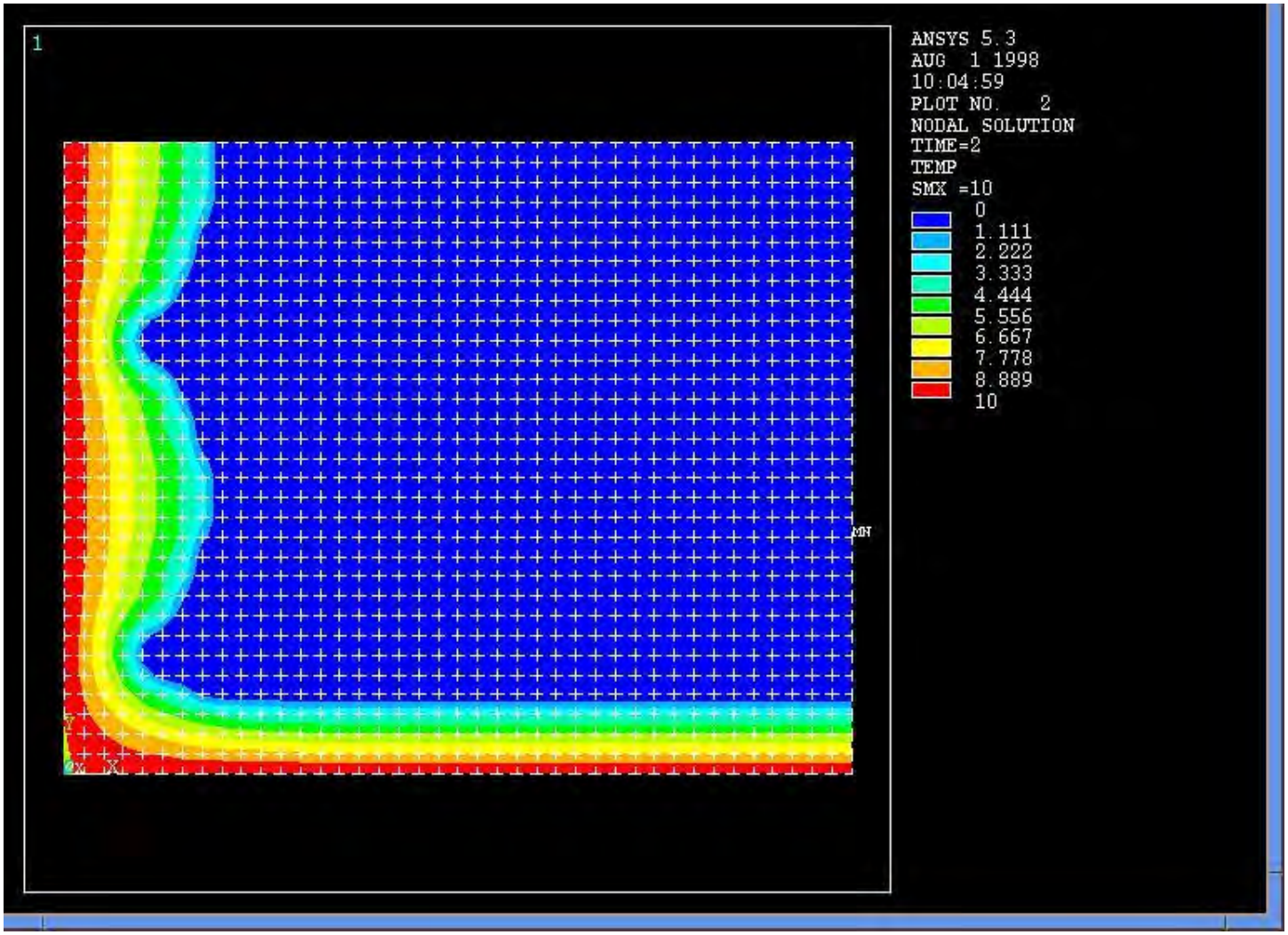
Oxygen Composition in the Discolored Region Near an Open Hole



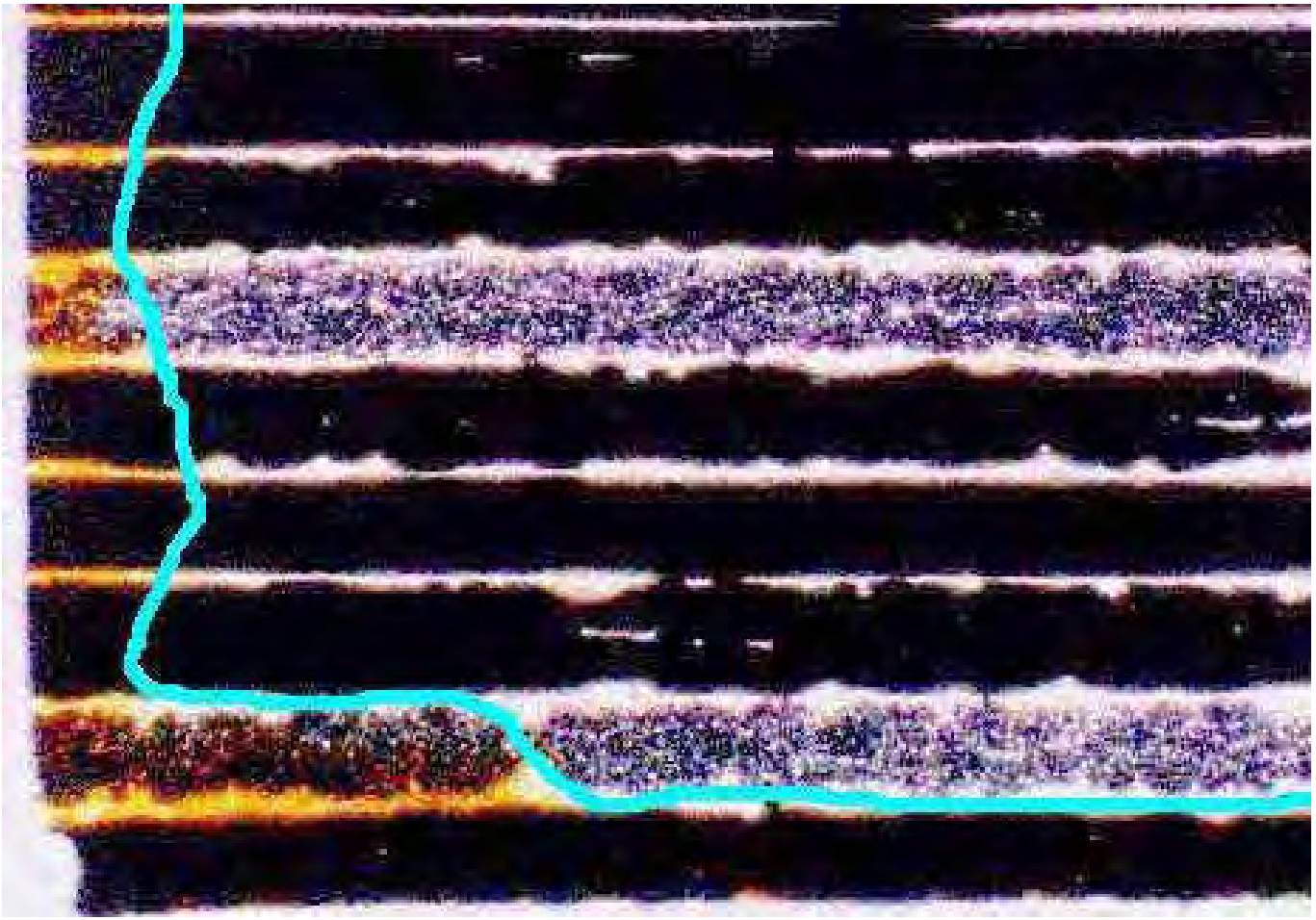
IM7/5260 Quasi Isotropic Laminate



Predicted Contours of Oxygen Concentration in IM7/5260 after 2000 hours

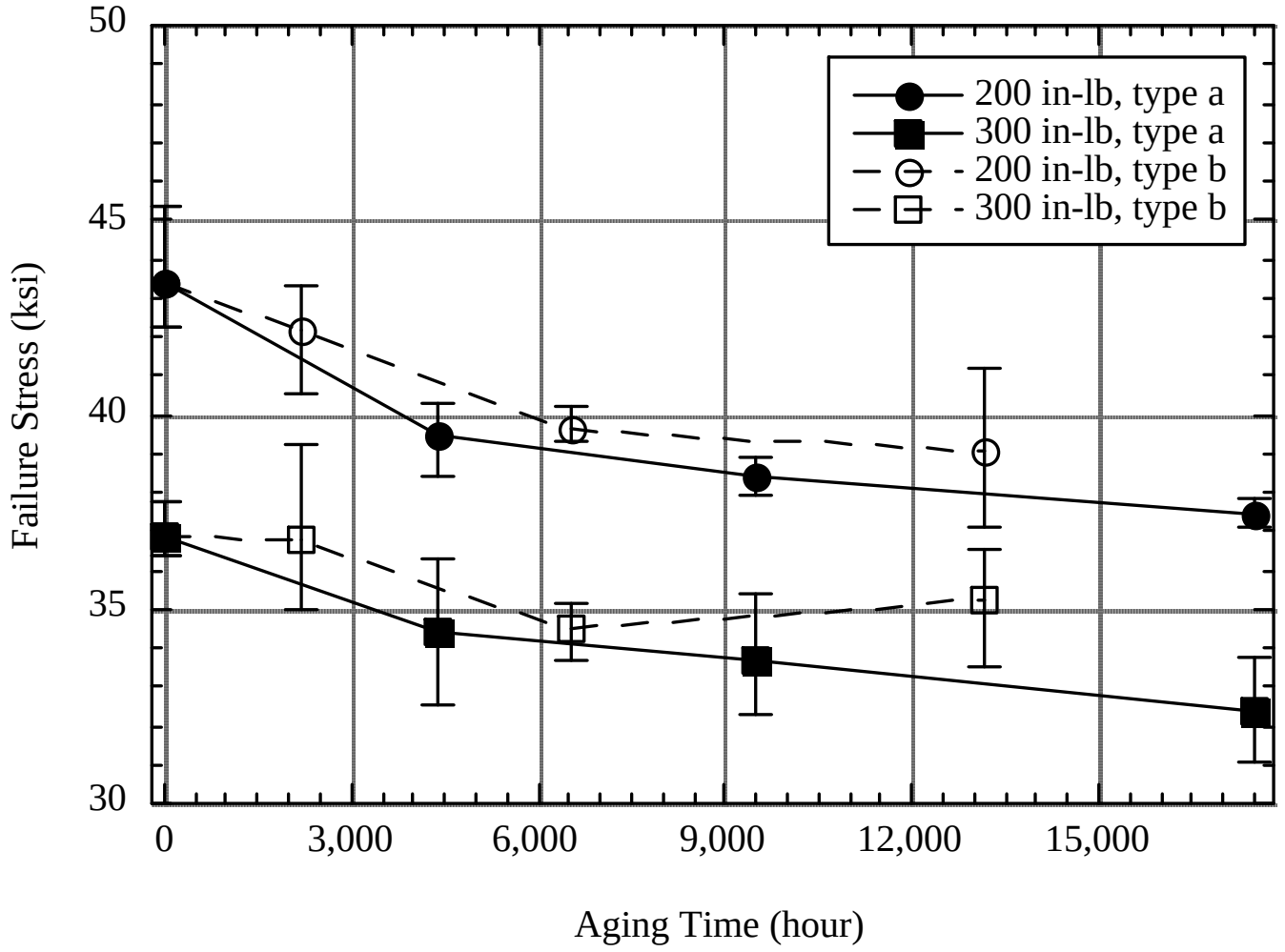


Measured Degraded Region in IM7/5260 aged at 300ºF, 2000 hours



Source: Boeing

CAI Strength vs. Aging at 300°F for IM7/K3B Laminates



Objectives of Proposed Research

- To investigate aging effects on CFRP in hot-wet environment
- To study aging degradation mechanisms in CFRP at elevated temperature
- To develop analysis capabilities for predicting aging degradation in CFRP