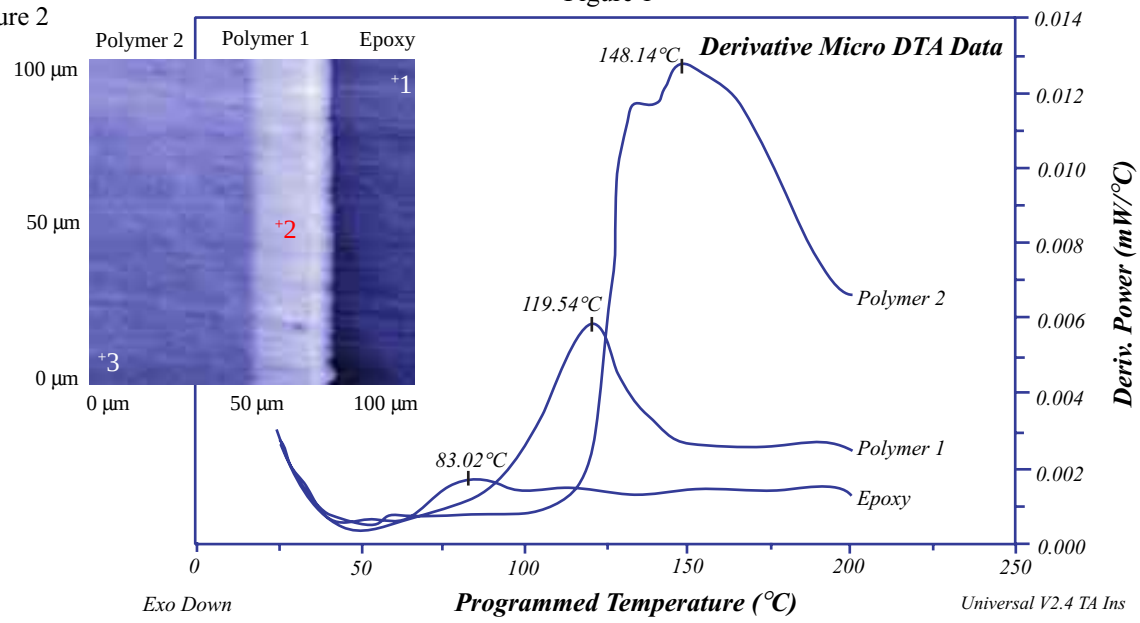
THERMAL SOLUTIONS

Multi-Layered Polymer Film Characterized by Micro Thermal Analysis - Local Thermal Analysis

Figure 1

Figure 2



Micro thermal analysis (µTA) uses a tiny resistive thermal probe within an atomic force microscope (AFM) to collect images related to sample topography and thermal conductivity. Using the images as guides, points can then be selected for further examination by local thermal analysis (LTA). In this technique, the probe is positioned at the selected points and the temperature is ramped from a predetermined start to a predetermined final temperature at very high ramp rates (5-25°C/s). Signals analogous to TMA and DTA are collected simultaneously in the LTA experiments. A modulated temperature signal can also be superimposed upon the base ramp to increase sensitivity.

Figure 1 illustrates the use of LTA's to detect melting transitions in a multilayered polymer film sample. The sample was a three layer polymer film. The sample was mounted on edge in epoxy and micro-tomed. Figure 2 is a thermal conductivity image taken at 50°C and indicates the central and one outer polymer layer, and the epoxy mount.

Excellent thermal conductivity contrast between the three materials is achieved providing visual distinction of all three polymers. Three separate positions, each in a different layer and indicated by the crosshairs in the image, were chosen and thermal scans were taken from 25-200°C at a rate of 10°C/s. The data displays the derivative of the micro differential thermal signals (µDTA). The derivative of power to the probe allows one to clearly locate peaks to aid in the qualitative comparison of different materials. A glass transition is detected in the epoxy by a peak at ~ 83°C while different melting transitions are identified by peaks at ~120°C and ~148°C. These transitions allow one to uniquely identify each layer within the system. Total time for all three experiments: ~1.5 minutes.