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.

Multicomponent polymer systems find many applications today. This application note demonstrates µTA's ability to aid processing problems. The topography image above shows a 100 µm² scan taken on a multicomponent polymer system. After annealing the sample, the surface had a hazy appearance instead of the normal glossy finish. Microscopic methods revealed that the surface was not smooth, as expected, but bumpy. This is confirmed in the AFM image above. The tallest features were ~1 µm in height. It was suspected that the bumps were one polymer component and the space between the bumps was another, but it was beyond conventional thermal methods to prove this.

After collection of the topographic image, the 2990’s software was used to position the probe at the two indicated points: one on top of a bump and the other in a flat area between bumps. Local thermal experiments were performed at each position. The temperature was ramped from room temperature to 200°C at 10°C/s. Figure 2 plots the resulting micro TMA data curves. The data indicate that the bump softens a few degrees higher than the flat area; in the example above 167°C versus 163°C. More importantly, however, there is a noticeable transition in the TMA signal on the bump occurring at ~61°C. This indicates a glass transition (expansion of the sample, followed by slight penetration of the probe, followed by continued expansion), and leads to the conclusion that the bump and flat areas are indeed two different polymers.