Thermomechanical analysis (TMA) is a technique widely used to determine transition temperatures and expansion/contraction properties of materials, including the coefficient of thermal expansion ($\alpha$). When determining $\alpha$, however, there are three factors which need to be considered to obtain reproducible quantitative results. These are TMA sensitivity and baseline drift, sample thickness, and the magnitude of $\alpha$.

The TA Instruments TMA has a maximum sensitivity of 15 nm, a displacement resolution of 0.5 μm, and a baseline drift of 1 μm (typically, 0.5 μm between 0 to 500 °C). Therefore, the recommended measured sample dimensional change over this range for determinations is >5 μm (roughly 10x the baseline drift). Knowing this, the minimum sample thickness required for testing can be determined from:

$$\alpha = \frac{\Delta L}{\Delta T} \cdot \frac{1}{L_o} \rightarrow L_o = \frac{\Delta L}{\Delta T} \cdot \frac{1}{\alpha}$$  \hspace{1cm} (1)

where:
- $\Delta L$ = measured dimension change
- $L_o$ = original sample thickness
- $\Delta T$ = temperature range of measurement

For example, a material with an expected $\alpha$ of 50 μm/m°C would yield a recommended minimum sample thickness for testing of:

$$L_o = \left( \frac{5 \text{ μm}}{500 \text{ °C}} \right) \cdot \left( \frac{1}{50 \text{ μm/m °C}} \right) = 200 \text{ μm}$$  \hspace{1cm} (2)

This minimum sample thickness will obviously change with $\alpha$ and temperature range. Clearly, it is better to use samples much thicker than this minimum if possible, as this will further improve signal-to-noise ratio.

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