DMA TTS based-Material comparison

The first part of this work introduces the technique of dynamic mechanical analysis (DMA) and deals with nonisothermal DMA measurements. The second part will cover various aspects of isothermal measurements, concentrating primarily on frequency-dependent elasticity.

Introduction :

By the term elasticity we mean the way in which materials change their shape through the action of external forces. The modulus of elasticity of a material is the ratio of the mechanical stress to the relative deformation. In Dynamic Mechanical Analysis, DMA, a sample is subjected to a sinusoidal mechanical deformation of frequency, f, and the corresponding forces measured. Conversely, the sample can be subjected to a defined force amplitude and the resulting deformation measured.

Measurement modes

A number of different measurement modes are used: - Shear for samples with a shear modulus in a very large range from about 1 kPa to 2 GPa. This allows viscous liquids and even solid samples, e.g. polymers in the glassy state, to be measured. - Three-point bending for stiff samples with a modulus of elasticity of up to 1000 GPa. - Single and dual cantilever bending for samples that deform too strongly with three-point bending. - Tension for thin bars, films and fibers. - Compression for samples with a modulus of elasticity of up to about 1 GPa

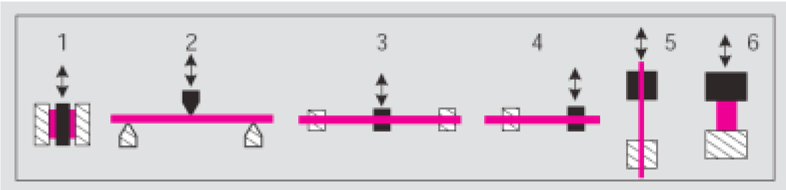

Fig. 1. DMA/SDTA861e measurement modes: 1 shear; 2 three-point bending; 3 dual cantilever (similar to bending but the sample is fixed); 4 single cantilever; 5 tension for thin bars, films and fibers; 6 compression.The clamping assembly is colored black and the sample red. The hatched areas show the parts of the clamping assemblies that remain fixed in position.

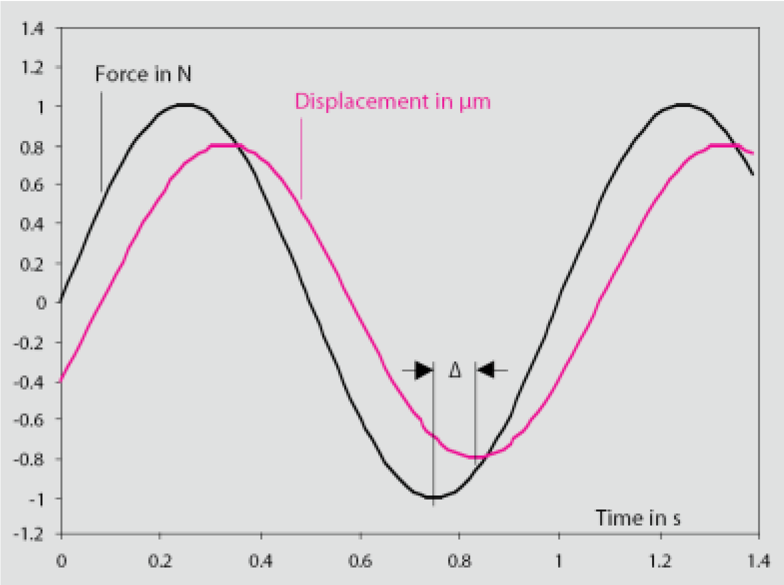

Fig. 2. Force and displacement at a frequency (f) of 1 Hz. The phase shift, δ, can be calculated from the time delay, Δ, using the equation $\delta = 2\pi f\Delta$.

Viscoelastic Material Characterisation Database