Direction Measurement of the Mechanical Strength of Single Microcapsules by Micromanipulation

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Abstract

Mechanical characterization of microcapsules is essential if physical damage to them in processing, handling and transport is to be minimised, and/or their performance at end use is to be optimized, particularly for those applications relying on using a mechanical force as a trigger to release their core material. Different experimental techniques can be used to characterize the mechanical properties of microcapsules, including indirect and direct methods on a population of microcapsules or single microcapsules. Among them, diametrical compression of single microcapsules using micromanipulation has many advantages. This technique is based on compression of single microcapsules between two flat surfaces and simultaneous measurement of the force applied to them. Valuable mechanical property parameters can be obtained from such measurements, including the force required to cause a given deformation of the microcapsules, size, visco-elastic, elastic-plastic behaviour, rupture force and deformation at rupture. Mathematical modelling of the force versus deformation data with appropriate constitutive equations of the materials can be used to determine their intrinsic mechanical property parameters, such as Young's modulus, shell thickness, yield stress and stress/strain at rupture.

The micromanipulation technique has been used to measure the mechanical properties of microcapsules with different chemical composition and structure relevant to various industrial applications. The details of this technique, the measurement results and their significance will be presented.