

Fast temperature screening for viscosity determination of thermoresponsive polymers by microfluidic

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Viscosity is an essential physical property when studying polymers behavior. However rheological studies remain a challenging task for many laboratories as traditional techniques are time consuming and do not allow to measure samples in desired conditions. We propose a new instrument: FLUIDICAM to measure viscosity as a function of shear rate and temperature in a single experiment set-up. Using a small sample volume, the technology allows flow viscosity measurements of liquid products from water-like inks to thick cosmetic formulations, under a wide range of shear rates (including high values up to 105 s^{-1}).

During the measurement a sample and a viscosity standard are pushed together through a microfluidic chip (Y-junction) at controlled flow rates. Images of the resulting laminar co-flow are acquired with digital camera and the position of the interface is measured. The position is related to the viscosity and the ratio of flow rates between the sample and the reference allowing to determine the viscosity.

In this work, bio triblock copolymers (Poloxamers - $(\text{PEO})_x(\text{PPO})_y(\text{PEO})_x$) and PNIPAm (Poly(N-isopropylacrylamide)) were studied. They are well known for their reversible phase transitions (sol-gel) under specific thermal conditions and thus they are good candidates for innovative drug delivery systems. We have used solutions at various concentrations to measure the viscosity between 5 and 80°C in less than an hour (5min per temperature step). This work will demonstrate the influence of the polymer concentration on viscosity variation and prove the capabilities of FLUIDICAM to conduct fast temperature screening measurements.