A new integrated Rheo Small Angle Light Scattering (Rheo SALS) device

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Small Angle Light Scattering (SALS) is a widely used optical technique for investigations of micrometer sized structures. In a SALS setup the light of a laser is directed onto the sample and the scattered light at small angles is detected by a 2-dimensional detector. SALS gives information on the structure averaged over the whole scattering volume. Light scattering like other scattering methods, i.e. x-ray or neutron scattering, measure an intensity distribution in the so-called momentum space. This means large structures show scattering to small angles whereas small structures lead to scattering at large angles. Typical applications of a Rheo-SALS device cover all kinds of complex fluids like surfactant solutions, colloidal suspensions, emulsions, polymer solutions, and polymer blends.

SALS has been used frequently in combination with applied flow field to investigate structural changes induced by flow. However, a combination of a SALS setup with rotational research rheometer (Rheo-SALS) would be more suitable for detailed investigations on structure-property relationships of complex fluids. A variety of such devices have been designed at several University laboratories.

However, to make Rheo-SALS methods more commonly available a new device has been developed. It consists of a SALS module which can be easily adapted to a commercially available rheometer. The SALS module itself uses a laser diode as light source. The laser diode is mounted together with a prism and a polarizer directly onto a rheometer flange. Located on the same flange a temperature controlled measuring cell is mounted. Concentric cylinder or parallel-plate geometries can be used. The scattered light within an angle of 11° is collected by an optical lens system and directed onto a screen. A beam stop removes the unscattered primary beam. The scattering patterns on the screen are recorded by a CCD camera.

Details of the new Rheo-SALS device as well as simulation results on the performance of the optical lens system are presented. As application examples results of Rheo-optical investigations on a model polymer blend and a surfactant system are shown.

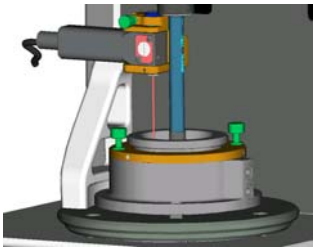

Fig. 1: SALS setup

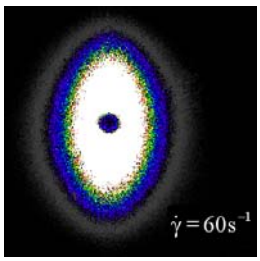

Fig. 2: Scattering pattern of a polymer blend