X-ray rheometer

Published date: Aug. 20, 2012

Technology description

Summary

The present invention relates to a device and a method for the combined rheological and X-ray examination of materials in a rheometer. Such combined examinations are of interest for scientific and industrial applications, in which the changes in the microstructure of viscous materials under the effect of shear forces for capturing viscoelastic measurements should be examined. This includes the deformation and reorientation of particles or molecules in fluid systems under the influence of shear forces and the corresponding shear stress and shear strain, for example. The changes in the microstructure show up in changes in the X-ray scattering pattern that is detected by a position-sensitive X-ray detector. A few application examples include examinations of melting (plastics, metals), paints, lubricants and cosmetic creams and lotions. The present invention was only able to show a wide range of shear-induced orientations in viscoelastic materials when the X-ray beam was directed at an angle of less than 45°, preferably less than 20° on the material, regarding the vertical rheometer axis of a rheometer with either a cone-plate or a plate-plate configuration.

Problem

Many variations of rheometers are available on the market, as well as combinations with optical microscopes and light scattering. However, a new rheometer had to be developed for the planned combination of rheology and X-ray diffraction.
This could be implemented on the basis of the Mars rheometer of Thermo Fisher, Karlsruhe. Furthermore, special x-ray optics for the beam deflection, rheometer geometries with especially low absorption of X-ray beam and tempering cells, which allow the trouble-free admission and emission of the X-ray beam, needed to be developed.

Innovation

A construction which enables the characterisation of randomly oriented viscoelastic samples by X-ray diffraction and scattering has been designed, developed, and completed. In this case, it has especially been innovative that both rheological parameters and structural parameters are simultaneously

accessible. This also means that the viscoelastic characteristics of a sample can specifically be adjusted and controlled by the rheometer during the expermient.

Advantages

The construction runs in user operation at BW1, Doris III and DESY. Furthermore, it shall also be transferred to PETRA III.

Institution

DESY Deutsches Elektronen-Synchrotron