Dispersion Stability of Carbon Black Suspensions by the Addition of Polymers

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In order to confirm changes in the aggregates in the carbon black suspensions dispersed in Nafion solutions under shear flow, an experiment using a rheometer-base shear flow apparatus for a small angle neutron scattering SANS-U instrument of Institute for Solid State Physics, the University of Tokyo at JAERI Tokai has been performed as functions of the scattering vector and the shear rate at the carbon black concentrations of 5.0 wt and 8.0 wt % and the ambient temperature. Nafion was adsorbed on the carbon black surfaces and it played a role in the stabilization of carbon black suspensions. After sedimentation of the carbon black suspensions, whose surfaces were covered by adsorbed Nafion using a centrifuge, the sedimented carbon black suspensions were washed several times to remove free Nafion chains by the dispersion media and the re-dispersed carbon black suspensions were obtained. The neutron scattering intensities of the re-dispersed carbon black suspensions clearly depended on the shear rate. However, it is noticed that the scattering patterns show two power-law regimes, irrespective of the shear rate: At at low q, a weak slope of ?2.3 corresponds to a mass fractal regime, whereas at high q, a power law ?3.6 is observed for the surface fractal of the primary particle. This means that the basic fractal structures of the carbon black suspensions are maintained even under shear flow. Moreover, changes in the neutron scattering intensities with an increase in the shear rate are well correlated with the shear flow behavior of the corresponding carbon black suspension. Therefore, for the first shear thinning regions and the plateau shear viscosity regions at the shear rates less than 50 s-1 the neutron scattering intensity rapidly decreases and attains the minimum due to the partial breaking down the aggregated structures of the carbon black suspensions under shear flow, whereas for the second shear thinning regions with an increase in the shear rate beyond at the shear rate of 50 s-1 the corresponding neutron scattering intensity grows up and approaches to a constant value above at the shear rate of 200 s-1 due to the formation of some newly ordered structures of the partial ruptured carbon black suspensions under higher shear flow. Thus, changes in the neutron scattering intensities seem to be well correlated with changes in the structures in the carbon black suspensions under shear flow.