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Dispersions of Carbon Black in Microemulsions

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Abstract : In order to enhance the energy and power densities of electrodes for energy storage systems, the formulation and processing of electrode slurries proved to be a critical issue in determining the electrode performance. In this study, we introduce novel approach to formulate carbon black slurries based on microemulsion and lyotropic liquid crystalline phases (namely, lamellar phase) composed of non-ionic surfactant (Triton X100), decanol and water. Simultaneous measurements of electrical properties of slurries under shear flow (rheology) have been conducted to elucidate the microstructure evolution with the surfactant concentration and decanol/water ratio at rest, as well as, the structural transition under steady-shear which has been confirmed by rheo-microscopy. Interestingly, the carbon black slurries at low decanol/water ratio are weak-gel (flowable) with higher electrical conductivity than those at higher ratio which behave strong-gel viscoelastic response. In addition, the slurries show recoverable electrical behaviour under shear flow in tandem with the viscosity trend. It is likely that oil-in-water microemulsion enhances slurries' stability without affecting on the percolating network of carbon black. On the other hand, the oil-in-water analogous and bilayer structure of lamellar phase cause the slurries less conductive as a consequence of losing the network percolation. These findings are encouraging to formulate microemulsion-based electrodes for energy storage system (lithium-ion batteries).

Keywords : electrode slurries, microemulsion, microstructure transition, rheo-electrical properties
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