

Polyaniline: Reaction Profiling Using Laser Light Scattering

Polyaniline is one of the most popular conducting polymers because of its wide applications in various areas. However there is great interest in being able to control its morphology (fibrillar vs. granular) due to extended applications. In this study, we attempt to determine why the morphology changes in different aniline polymerization systems.

Conventional chemical oxidative polymerization of aniline in dilute aqueous acids and ammonium peroxydisulfate oxidant proceeds via the intermediacy of colorless soluble molecular aggregates, whose size and shape plays a key role in the overall morphology of the polyaniline precipitate obtained (granular vs. fibrillar). These aggregates can be detected by monitoring the polymerization reaction using static and dynamic laser light scattering *simultaneously*.

During the early stages of the reaction, i.e., the induction period—before the onset of polymerization—large aggregates were observed in the range of 40–350 nm, depending on the synthetic conditions. The simultaneous determination of radius of gyration (R_g , static LS) and the hydrodynamic radius (R_h , dynamic LS) of these aggregates during the reaction, permits one to measure their size and shape *directly*.

Rod like aggregates ($R_g/R_h > 2$) were detected using static and dynamic light scattering techniques when the polymerization conducted *without* the addition of NaCl, in which the bulk product have nanofibrillar morphology. With the *addition* of NaCl, spherical micelles were observed ($R_g/R_h < 1$) and resulted in bulk product having a granular morphology.

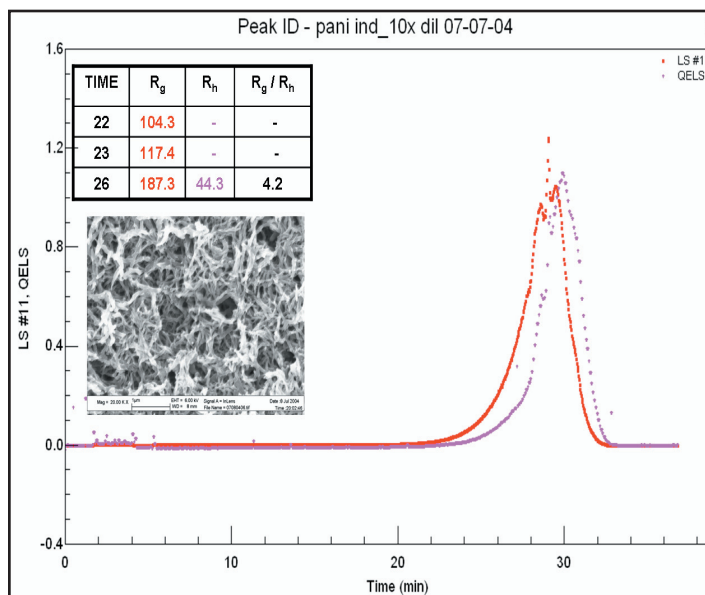


Figure 1. Polyaniline nanofibers obtained when the rod-like aggregates formed at the induction period of polymerization.

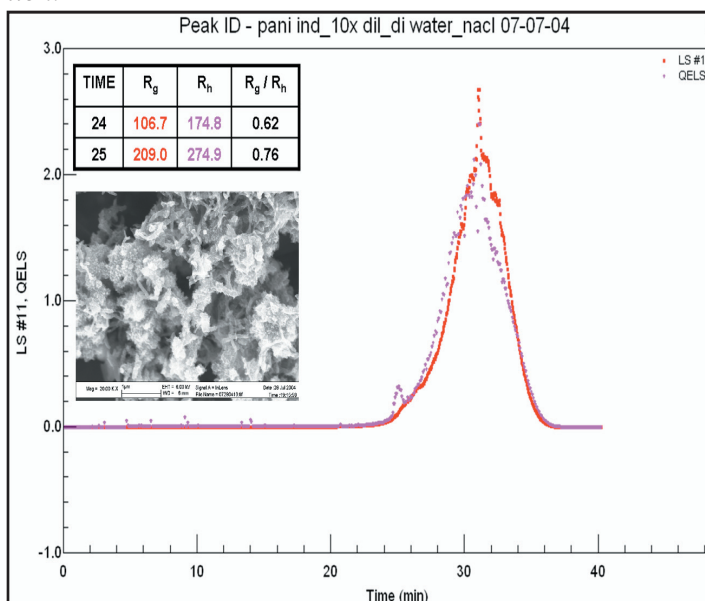
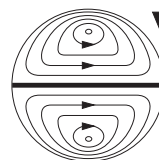


Figure 2. Polyaniline particulates when the spherical aggregates formed at the induction period of polymerization.

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