Continuous reprecipitation process for fabrication of polyimide nanoparticles using microfluidic system

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Supplementary Informations

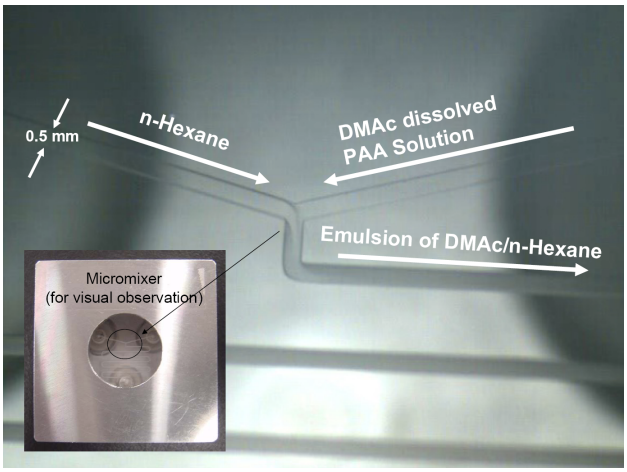

Figure 1S Image at the mixing point of n-hexane and DMAc solution. The DMAc solution with PAA stream from the right side and n-hexane stream from the left were mixed. The homogeneous emulsion with micrometer to nanometer sized droplets can be observed after the mixing point.

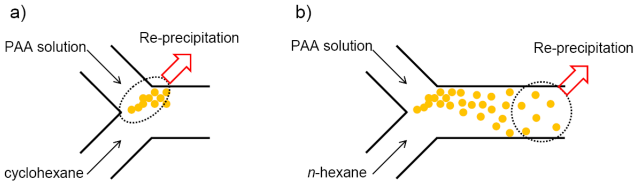

Figure 2S Schematic diagram of the proposed mechanism of reprecipitation of PAA in (a) cyclohexane and (b) in n-hexane. For cyclohexane, the droplets still localized densely around the mixing point (a); then the reprecipitated droplets easily aggregated and led to the occlusion within a short time. Alternatively, when n-hexane was used in this system (b), sufficient DMAc solution with PAA in n-hexane was formed by stable homogeneous emulsion.

Additional Experimental Details

Materials used are poly[4,4'-oxydiphenylene-pyromellitimide] (PMDA-ODA) as a precursor polymer of PI (polyamic acid (PAA), see scheme 1), *N, N*-dimethylacetamide (DMAc) as a solvent of PAA, n-hexane, pyridine as a catalyst, and acetic anhydride as a dehydrating agent. All the chemicals were purchased from Sigma-Aldrich Chemical Co. and used without further purification.

The imidization was proceeded by pyridine with acetic anhydride as the catalysts and the rate was ca. 0.9. In our experiment, we confirmed quantitative imidization after thermal treatment without deformation of particles. The estimated reaction rates of imidization have also reported by IR absorption measurements[1S].

Analysis of the obtained nanoparticles was carried out using scanning electron microscopy (SEM, S-4800, Hitachi Co. Ltd.) with acceleration voltage of 1 kV and emission current of 10 μA.

Reference

1S T. Nishino, M. Kotera, N. Inayoshi, N. Miki, and K. Nakamae, *Polymer*, 2000, **41**, 6913.