Materials Science

15A/2007G508

Synthesis of Silver Particles in Tween20/Water/Ionic Liquid Microemulsions

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Introduction

Developments of room-temperature ILs as a reaction medium for inorganic nanomaterials have received much attention and could offer many opportunities and challenges for the synthesis of nanoparticles with unique shape and structures [1-3]. Although many researches have been performed focusing on the synthesis of metal nanoparticles in ILs, there are a few reports that described the reduction of metal ions and the time evolution of the formation of metal particles and aggregates in water-in-ILs microemulsions. In this study we have synthesized Ag particles by the photoreduction of silver perchlorate ($AgClO_4$) in the water-in-ILs microemulsions constituted of Tween20/water/1-butyl-3-methylimidazolium tetrafluoroborate ([BMIm][BF_4]) and Tween20/water/1-octyl-3-methylimidazolium tetrafluoroborate ([OMIm][BF_4]) ternary systems by means of SAXS measurements.

Experimental

Colloidal dispersions of Ag particles were synthesized by the photochemical reduction of $AgClO_4$ in the presence of Tween 20 in water-in-[BMIm][BF_4] or water-in-[OMIm][BF_4] microemulsions. For example, 2 mL of Tween 20 was added to 4 mL of [BMIm][BF_4], followed by the addition of 5 mg benzoin and mixed vigorously. Just before the irradiation of a 500W super-high-pressure mercury lamp, 20 μL of 1.32 M $AgClO_4$ aqueous solution was added to the mixture solution with the simultaneous ultrasonication. Subsequently, the Ag^+-containing water-in-[BMIm][BF_4] microemulsions obtained were poured into a quartz cell, and the irradiation of UV-light was started with continuous stirring using a magnetic stirrer. In this case, the weight fraction of Tween20 was 0.33, and the [BMIm][BF_4]-to-Tween20 molar ratio (R) and the water-to-Tween20 molar ratio (w) was 8.7 and 0.62, respectively. SAXS measurements were performed at BL-15A. The scattering data was collected by a position sensitive proportional counter (PSPC).

Results and Discussion

Fig. 1 shows the SAXS profiles of the colloidal dispersions of Ag particles in the (a) water-in-[BMIm][BF_4] and (b) water-in-[OMIm][BF_4] microemulsions in the presence of Tween 20 before and after the photoirradiation. SAXS profile of the Ag^+-containing water-in-ILs microemulsions in the absence of Tween 20 is also shown in addition to that of pure ILs without Ag^+ ions. The following observations are worth noting. (1) A strong scattering peak is observed in the pure [OMIm][BF_4] while a monotonously increasing scattering is observed in the pure [BMIm][BF_4]. (2) Addition of $AgClO_4$ into both pure ILs induces an increase in scattering intensity at a small q-range (q < 1.0 nm^{-1}), suggesting that Ag^+ ions affect the structure of the water droplets dispersed in the ILs with keeping the ordered nanodomains of ILs. (3) Addition of Tween 20 into the Ag^+-containing ILs makes a drastic change of the interference peak position in both ILs. The detailed analysis is in progress.

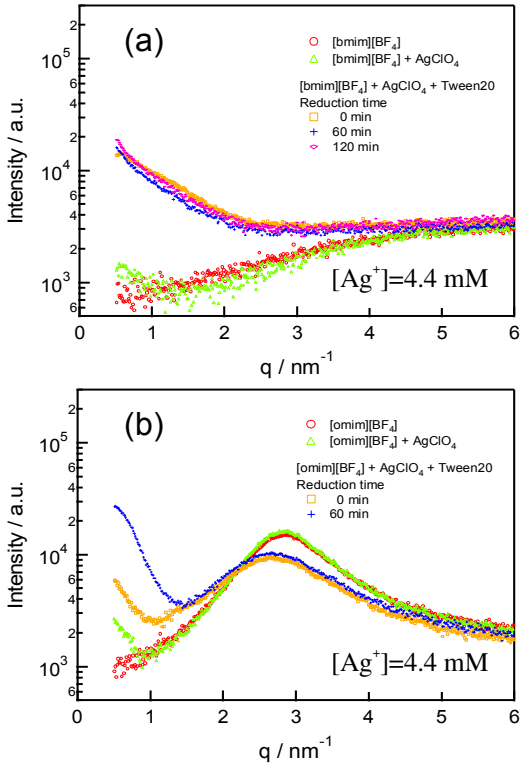

Fig. 1. SAXS profiles of the colloidal dispersions of Ag particles.

References

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