Preparation of Poly(methyl methacrylate)/Ag Microparticles Using Suspension Polymerization in the Presence of Modified Ag Nanoparticles

Ran Kim[1], Sung-min Park[2], Ji-yeun Kim[2], In-kyo Kim[1], Byung-chul Ji[1], and Jeong-hyun Yeum[1]

[1]Department of Advanced Organic Materials Science and Engineering, Kyungpook National University, Daegu, 702-701, Korea
[2]Korea Dyeing Technology Center, Daegu 703-834, Korea
E-mail: jhyeum@knu.ac.kr

1. INTRODUCTION

Recently, control of the morphology of particles has become an intensive area due to the important effects of particle morphology on the physical properties of the particles. In our previous study, the polymer/Ag microspheres were prepared using suspension polymerization of monomer in the presence of hydrophilic Ag nanoparticles [1-3]. However, the hydrophilic Ag nanoparticles could not embed into polymer matrix uniformly but formed aggregates. In order to disperse the Ag nanoparticles in polymer matrix, hydrophilic Ag nanoparticles were modified by an oil-soluble surfactant, polyethylene glycol (30EO) dipolyhydroxystearate (Arlacel P135), which is commonly used for preparing water-in-oil (W/O) emulsion.

2. EXPERIMENTAL

To prepare PMMA/Ag nanocomposite microparticles, 0.06–0.54 g of Arlacel P135 was dissolved in 60 ml MMA monomer. After the surfactant Arlacel P135 was dissolved, 3.6 ml of Ag nanoparticles in water suspension (10,000 ppm) and desired initiator (0.0001 mol/mol based on MMA) was mixed with 60 ml MMA monomer under ultrasonification for 5 min using Bandelin UW 3,100 equipment. The polymerization of MMA in the presence of aqueous Ag nanoparticle dispersion was conducted at different temperatures under N_2. After predetermined times, the reaction mixture was cooled and kept for 1 day to separate the PMMA/Ag spheres.

3. RESULTS AND DISCUSSION

The Ag nanoparticles and their surface hydrophilicity play an important role in the polymerization rate and the morphology of PMMA/Ag microparticles. In the case of using modified Ag nanoparticles, the polymerization rate increased slightly. PMMA/Ag microparticles with conversion up to 85% were prepared in spite of the low polymerization temperature. Due to the change of hydrophilicity of Ag nanoparticles, different appearances of the microparticles having golf ball-like convex surfaces or concave surfaces were observed.

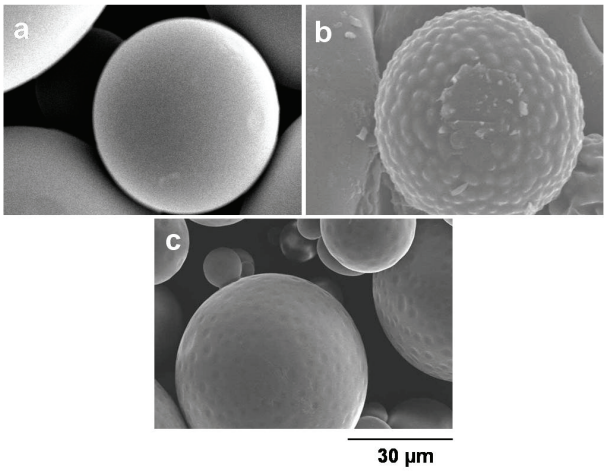

Fig. 1. SEM photographs of (a) pure PMMA, (b) PMMA/Ag microspheres without surfactant, (c) PMMA/Ag microspheres with surfactant.

4. ACKNOWLEDGEMENT

This research was financially supported by the Ministry of Education Science Technology (MEST) and Korea Institute for Advancement of Technology (KIAT) through the Human Resource Training Project for Regional Innovation.

5. REFERENCES

[1] J.H. Yeum and Y. Deng; *Colloid Polym. Sci.*, 283, 1172 (2005).
[2] J.H. Yeum, S. Qunhui, and Y. Deng; *Macromol. Mater. Eng.,* 290, 78 (2005).
[3] E.M. Lee, H.W. Lee, J.H. Park, Y.A. Han, B.C. Ji, W. Oh, Y. Deng, and J.H. Yeum; *Colloid Polym. Sci.*, 286, 1379 (2008).