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Pickering emulsion droplets for thermally expandable microcapsule with core-shell structure using β-cyclodextrin

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Introduction: The automotive industry is applying enhanced legislation on environmental protection and CO_2 emissions regulations from exhaustion petroleum resources, and for this reason it is likely that the automotive industry will be able to improve its fuel efficiency. Various polymeric foam molding studies are being performed to achieve the additional light weight effects of polymeric materials to the extent allowed by mechanical properties. The use of three dimensional stabilizers or surfactant used in the manufacture of microcapsule for light-weight is used to prevent the liquid products from forming together during the polymerization process. However, the use of large quantities of surfactants exist results from the reaction, and the residual surfactant requires a post-reaction removal process. Accordingly, the purpose of this study is using a Pickering emulsifier without an surfactant, create a Pickering Emulsion which are slightly emulsified to a soluble solvent and manufacturing thermally expansion microcapsules that have a better size distribution.

Experimental : Steps to prepare a continuous phase, including antioxidant, inhibitor, salts, the Pickering emulsifier, and soluble solvents ; to prepare disperse phase that contain blowing agent with monomers and initiator; Microcapsule shells consist of acrylonitrile(AN) and methyl methacrylare(MMA). With aiming to prepare microcapsules having a particle size of 1000-200 μm. β-Cyclodextrin(β-CD) and poly(vinylpyrrolidone)(PVP) were used as Pickering emulsifier and stabilizer, respectively.

Characterization : The particle morphology was investigated by SEM, and OM. Particle size distribution was measured using coulter. Thermo-gravimetric analysis(TGA) was conducted to investigate the content of blowing agent.

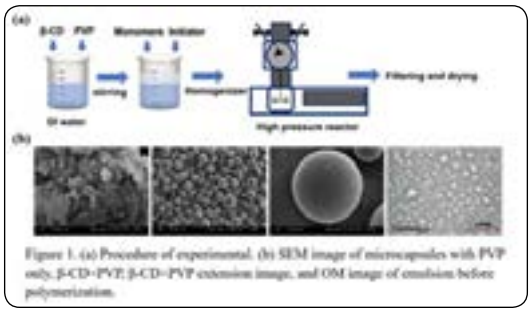

Figure 1. (a) Procedure of experimental, (b) SEM image of microcapsules with PVP only, β-CD+PVP, β-CD+PVP extension image, and OM image of emulsion before polymerization.

Recent Publications:

1. Kim, J. G., Ha, J. U., Jeoung, S. K., Lee, K., Baeck, S. H., & Shim, S. E. (2015). Halloysite nanotubes as a stabilizer: fabrication of thermally expandable microcapsules via Pickering suspension polymerization. Colloid and Polymer Science, 293(12), 3595-3602.
2. Li, X., Li, H., Xiao, Q., Wang, L., Wang, M., Lu, X., ... & Zhang, J. (2014). Two-way effects of surfactants on Pickering emulsions stabilized by the self-assembled microcrystals of α-cyclodextrin and oil. Physical Chemistry Chemical Physics, 16(27), 14059-14069.
3. Chevalier, Y., & Bolzinger, M. A. (2013). Emulsions stabilized with solid nanoparticles: Pickering emulsions. *Colloids and Surfaces A: Physicochemical and Engineering Aspects, 439,* 23-34.
4. Inoue, M., Hashizaki, K., Taguchi, H., & Saito, Y. (2010). Emulsifying ability of β-cyclodextrins for common oils. *Journal of Dispersion Science and Technology, 31*(12), 1648-1651.

5. Zhou, C., Cheng, X., Zhao, Q., Yan, Y., Wang, J., & Huang, J. (2013). Self-assembly of nonionic surfactant tween 20@ 2β-CD inclusion complexes in dilute solution. *Langmuir, 29*(43), 13175-13182.

6. Mathapa, B. G., & Paunov, V. N. (2013). Self-assembly of cyclodextrin–oil inclusion complexes at the oil–water interface: a route to surfactant-free emulsions. *Journal of Materials Chemistry A, 1*(36), 10836-10846.

Biography

Ji-young Jung is graduate student of Department of Chemistry & Chemical Engineering in Inha University Republic of Korea. She research and study polymer in Polymer Nanomaterial Laboratory. There are two types of experiments under way. It is used for the manufacture of thermally expandable microcapsule for lightweight automotive materials and fabrication of hybrid polyurethane compounds for insulation.

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