Thermal Behaviors of Ionic Liquid and Nanoparticle Ionic Liquid

Xu Yiting(11229040), Song Yihu*, Zheng Qiang*

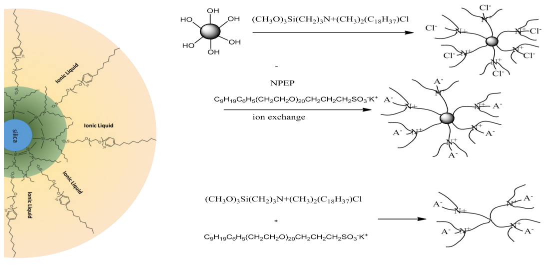
Department of Polymer Science and Engineering, Zhejiang University, Hangzhou, China, 310027

Rheo Lab

Introduction

Nanoparticles are commonly functionalized by grafting polymer chains on the surface in order to improve their dispersion in polymers[1]. A novel series of functionalized nanoparticles behaving like a solvent-free liquid at ambient temperature could be produced by adjusting the size of nanostructured core and molecular structure of grafting components[2]. As the most common type of solvent-free nanoparticles, nanoparticle ionic liquid(NIL) is synthesized through ionic-exchange reaction. The organic shell itself constituted of ionized oligomer molecules is usually a kind of non-volatile, non-flammable and thermally stable ionic liquid (IL) at ambient temperatures[3].

Experimental



Scheme 1 the preparation of IL and NIL

Results and discussion

Ⅰ. Morphological and chemical structures

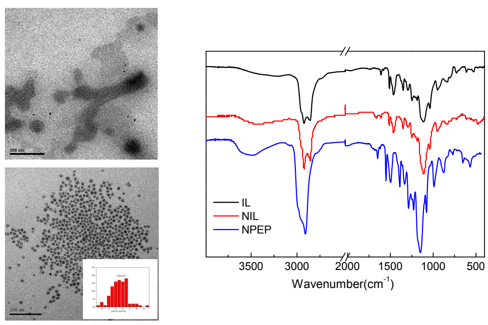


Figure 1. TEM micrographs of NIL and IL and FT-IR spectrum of NPEP, IL and NIL

Ⅱ. Crystallization behaviors

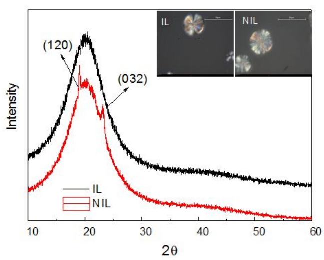


Figure 2. WXRD curves of IL and NIL crystallized at room temperature. The insect in shows POM photographs of the spherulites formed in IL and NIL at ambient temperature

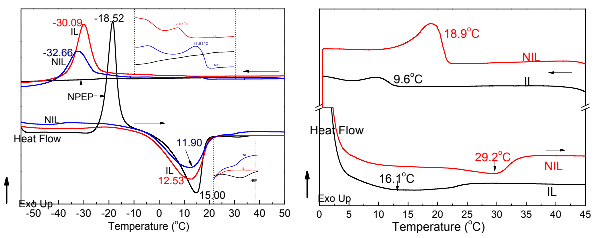


Figure 3. DSC cooling and successive heating traces of NPEP, IL and NIL The thin curves in (a) display enlarged plots of the marginal thermal transitions.

Ⅲ. Rheological behaviors

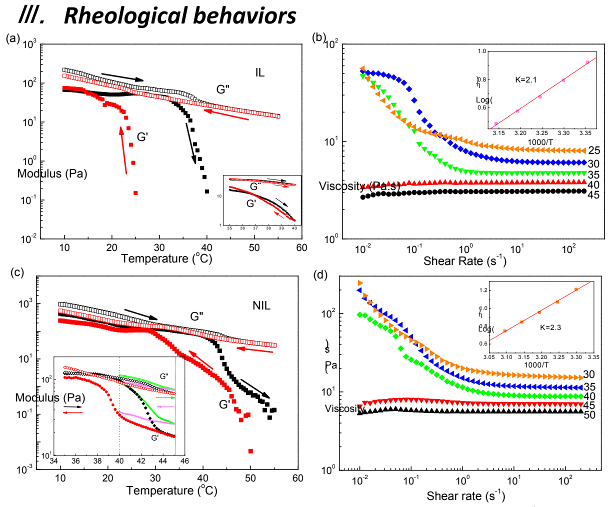


Figure 4. Temperature-sweep rheology for IL(a) and NIL(c) at a rate of 1 °C/min and 0.1 °C/min (the inset) during a heating-cooling run; Steady rheology of IL(b) and NIL (d) at various temperatures. The inset in (c) and (d) shows η at = 100 s^{-1} as a function of reciprocal temperature.

Conclusion

Here we synthesis IL and NIL through ion–exchange reaction. We find for the first time that both IL and NIL are able to form spherulites at room temperatures after a long-time aging. We observed shear thinning responses for both IL and NIL at temperatures where crystallites can be detected and Newtonian responses after the crystallites melt. We ascribed the thermal rheological hysteresis during heating-cooling temperature sweeps to the melting and crystallization behaviors of IL and NIL.

Acknowledgments

This work was supported by the National Nature Science Foundation of China (no. 51073136), the Fundamental Research Funds for the Central Universities of China (no. 2011QNA4011) and the Zhejiang Innovation Program for Graduates

Reference

1 Douglas, J. F. Nat Mater. **2009,** *8* (4), 354-U121;
2 Giannelis, E. P. *Adv Funct Mater.* **2005,** *15* (8), 1285-1290;
3 Weller, C. *Chem Eng Res Des.* **2008,** *86* (7A), 775-780.