Chapter 15
Ionic Liquids and Poly (Ionic Liquid)s Used as Green Solvent and Ultrasound Responded Materials

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ABSTRACT

Ionic liquids (ILs) have been known as a class of green solvent and played an important role in green chemistry in recently years. Materials based on ILs, such as poly(ionic liquid) and polymer/ILs composites, are also widely investigated and possess many unique properties and applications. In this chapter, green solvent IL is reviewed and the responsive behavior of ILs based materials to external stimulus, like ultrasound (US), is introduced. Especially, it is described that FT-IR spectroscopy was effective for analyzing hydrogen bonding in ILs, polymeric ILs and PVA/IL composites. In addition, shear viscosity and viscoelasticity measurement and techniques of two-dimensional correlation and deconvolution are applied to analyze the change of interaction between IL to different substances and US responded behavior.

INTRODUCTION

Nowadays, ionic liquids (ILs) is widely investigated in different fields since their unique properties. The applications of ILs in green chemistry becomes a promising topic, since ILs have no vapor press. And ILs have been treated as a replacement for the traditional solvents. The interaction between ILs and different compounds strongly influence the properties of ILs. Therefore, the investigation of interaction between IL and different compounds and the change of the interaction under external stimuli are very interesting. In addition, the existence of hydrogen bonding network in ILs systems have been fully understood. While, the stimuli responsive behavior based on the change of hydrogen bonding network of ILs systems were also studied.
ILs is rare. In addition, recently studies have shown that ultrasound (UA), which is treated as a green technology, could change the hydrogen bonding network (Venegas-Sanchez, Tagaya, & Kobayashi, 2013b). However, researches on the interaction change in ILs systems under ultrasound have not been fully understood. In this chapter, green solvent IL is reviewed and the responsive behavior of ILs based materials to US is introduced. The change of hydrogen bonds in ILs systems was studies with FT-IR spectroscopy, shear viscosity and viscoelasticity measurement and techniques of two-dimensional correlation and deconvolution.

**BACKGROUND**

The history of ILs can be dated back to 1914 (Walden, 1914) for the first IL, [EtNH]_3-[NO3] (Mp: 12°C). The IL was reported as a kind of organic salt with melting point below 100°C and was consisted totally of cations and anions. Since some ILs are liquid in room temperature, they are also called room temperature ionic liquids (RTILs). As a well-known green solvent, ionic liquids (ILs) are actively studied in recent decades. ILs have hardly detectable vapor press as compared with the common used solvent, such as THF, DMF and chloroform and have been treated as a green solvent/medium. ILs also have other unique properties of high conductivity, negligible flammability, high thermal and electrical stability, wide electrochemical window, and the ability to dissolve many organic and inorganic compounds (Hallett & Welton, 2011; Welton, 1999). Therefore, IL was widely used in organic synthesis (Li, Yuan, Zheng, & Fang, 2012), material science (Rogers, 2007), separation process (Sun, Luo, & Dai, 2011), and electrochemical conductive layer (Lu et al., 2002). Figure 1 shows the commonly used cations and anions for the composition of ILs. One of the feature property of ILs is that different ILs could be prepared by together of different cations and anions. Therefore, the IL properties enable to changing hydrophilicity.

Figure 1. The structures of common used cation and anion