

INFLUENCE OF IMIDAZOLIUM IONIC LIQUID AND LIGHT INTENSITY ON POLYMER NANOSTRUCTURE WITHIN LYOTROPIC LIQUID CRYSTALLINE TEMPLATES

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Development of polymers utilizing self-assembled lyotropic liquid crystals (LLCs) templates and photopolymerization show promise in controlling structure on the nanometer scale. This method allows for tailoring and enhancement of material properties on organic materials that are not attainable in traditional polymers. However, this method often faces the problem of thermodynamically driven phase separation between the polymer and LLC templates that hinders control of the polymer local order and consequently polymers properties. (Figure 1) In this study, we investigate an alternative method to control hydrogel nanostructure using specific amounts of imidazolium ionic liquid and modulating the light intensity used in photopolymerization. Polymer structure was characterized through polarized light microscopy (PLM) and small angle X-ray scattering (SAXS) to examine the degree of LLC nanostructure retention during photopolymerization and understand the effect of ionic liquid concentration and light intensity.

Investigation of polyacrylamide structure revealed that LLC nanostructure is retained during photopolymerization at particular reactive ionic liquid concentrations and light intensities. Examination of water uptake properties revealed a surprising enhancement in the templated systems as compared to their isotropic counterparts. In addition, the effect of crosslinking density was explored regarding the retention of LLC order and alternations on the kinetic behavior. At intermediate crosslinking concentrations, the polymerization rate increases, successfully transferring the template order to the final polymer. Polymers displaying the original order also showed a significant increase in the rate and maximum water uptake, which were unattainable in isotropic controls. These results reveal a new method to control and retain nanostructure of a polymer during polymerization that could be valuable in the development of polymers with unique properties not accessible in typical bulk materials or polymer blends.

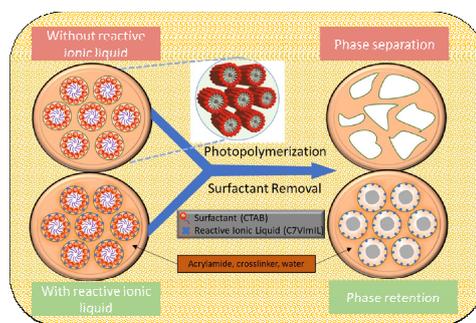


Figure 1: Representative LLC templating process used to generate a hexagonal nanostructure in organic polymers.