

# Effects of gelator 12-hydroxystearic acid (12-HSA) on ionic liquid based Pickering emulsions

Jin Zou, Denzil S. Frost, Lenore L. Dai\*

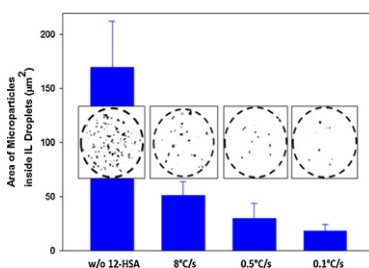
School for Engineering of Matter, Transport, and Energy, Arizona State University, Tempe, AZ 85287, United States

## HIGHLIGHTS

- ▶ 12-HSA gelled the IL–water interfaces but not the entire IL droplets.
- ▶ Interfacial morphology can be controlled by manipulating cooling rate.
- ▶ Cooling rate also affected particle transport across the interface.
- ▶ 12-HSA increased the stability of IL-in-oil Pickering emulsions.
- ▶ Phenomena unique to IL based Pickering emulsions could be tuned by organogelators.

## GRAPHICAL ABSTRACT

The presence of gelator 12-HSA gelled the ionic liquid (IL)–water interfaces rather than the entire IL droplets in IL-in-water Pickering emulsions. The morphology of the interfacial gelation could be manipulated by cooling rate which consequently controlled the transport of solid microparticles into the dispersed phase. The insets are sample images from ImageJ analyses and the particles are approximately 1  $\mu\text{m}$  in diameter.



## ARTICLE INFO

### Article history:

Received 31 May 2012

Received in revised form 25 July 2012

Accepted 1 August 2012

Available online 10 August 2012

### Keywords:

Gelator 12-hydroxystearic acid

Ionic liquid

Pickering emulsions

Interfacial gelation

## ABSTRACT

We have examined the perturbation effects of 12-hydroxystearic acid (HSA) on ionic liquid (IL)-based Pickering emulsions. The 12-HSA gelled pure 1-butyl-3-methylimidazolium hexafluorophosphate ([BMIM][PF<sub>6</sub>]) ionic liquid and polydimethylsiloxane (PDMS) oil effectively by the formation of entangled networks of thin fibers but not the water phase. In IL-in-water Pickering emulsions, the 12-HSA gelled the IL–water interfaces rather than the entire IL droplets since the 12-HSA partitioned into the water phase. In addition, we found that the morphology of interfacial gelation could be altered by manipulating cooling rate which provided a new way of controlling the solid particle transport into the dispersed phase. The 12-HSA effectively stabilized oil-in-IL Pickering emulsions by increasing the elastic modulus of the bulk phase and consequently overcoming the buoyancy force of the bridged droplets. These results indicate that phenomena unique to IL based Pickering emulsions can be tuned by the addition of an organogelator.

© 2012 Elsevier B.V. All rights reserved.

## 1. Introduction

Colloidal particles have received increasingly wide attention in a new application: Pickering emulsions. In these emulsions the

colloidal particles adhere to the emulsion droplet interfaces, forming an “armor” to protect the droplets against coalescence. Consequently, the most radical aspect of these emulsions is that there is no need for conventional surfactants. Ramsden [1] and later Pickering [2] were the first to report this phenomenon over a century ago, but only recently has interest resurfaced. The absence of surfactant makes these emulsions attractive for cosmetic, food, and pharmaceutical applications [3–5], where toxicity is an issue. Furthermore, functionalization of the colloidal particles can

\* Corresponding author at: ECG 301, 501 Tyler Mall, Arizona State University, Tempe, AZ 85287, United States. Tel.: +1 480 965 4112; fax: +1 480 965 3291.

E-mail address: [Lenore.Dai@asu.edu](mailto:Lenore.Dai@asu.edu) (L.L. Dai).