Pickering Interfacial Catalysis: a smart way to perform biphasic reaction with heterogenous catalyst

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PURPOSE OF THE ABSTRACT
Since the last two decades, the 12 principles of green chemistry have become essential criteria in both academia and industrial researches but yet still many processes require improvement. For instance, reactions producing stoichiometric amount of wastes, using hazardous intermediates or requiring high amount of energy should be replaced by eco-efficient, but more complex, catalytic systems. The difficulty further increases if liquid reagents are immiscible and/or the catalyst is heterogeneous arising from a strong mass transfer limitation. In order to solve the low liquid/liquid interfacial contact, two ways are most commonly employed: 1) addition of a co-solvent to improve the solubility of both phases, but at the same time, generating an amount of wastes if the co-solvent is not properly recycle; 2) Increase the stirring speed and design more complex stirrer to maintain an emulsion state during the reaction at the cost of large energy consumption. Surface active molecules could help to generate and stabilize the emulsion but compromise has to be done to avoid high emulsion stability which will inevitably impair product recovery.

Described since 1907, Pickering emulsions have just regained attention in the last decades in various applications in cosmetics, pharmaceutical products, food emulsifiers, and most recently, in catalytic processes. Pickering emulsions are solid-stabilized dispersions of two immiscible fluids. Compare to surfactant system, amphiphilic particles are strongly adsorb at the interface promoting a robust but still elastic interface. When these particles have additional catalytic properties, Pickering interfacial catalyst efficient bi-phasic reactions can be performed with ease product separation by centrifugation/filtration means.

This communication will describe how the amphiphilicity of the catalytic-solid affects the physicochemical properties of the Pickering emulsion. For instance, the droplet size is linked to the solid amphiphilicity affecting both the interfacial surface and the stability of emulsions. Applications of Pickering interfacial catalyst for biphasic acid and oxidation catalysis will be presented.
FIGURE 1
Pickering emulsion before and after centrifugation
The ease separation of the Pickering emulsion by centrifugation allows an efficient product/catalyst recovery.

FIGURE 2
Characterizations of the Pickering emulsions
(a) Microphotograph of a Pickering emulsion, (b) Schematic presentation of the amphiphilic NPs adsorption on a droplet, (c) Droplet diameter distribution profile as estimated from the microphotograph, the average diameter is shown by the arrow after log

KEYWORDS
Pickering interfacial catalysis | Pickering emulsion | Green chemistry | Biphasic catalysis

BIBLIOGRAPHY