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pH-triggered aqueous biphasic systems as integrated platforms in catalytic processes

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PURPOSE OF THE ABSTRACT

The ability to induce reversible phase transitions between homogeneous solutions and biphasic liquid-liquid systems, at pre-defined and suitable operating conditions, can be applied to design integrated production-separation processes. Switchable systems allow to carry out reactions in the monophasic region, after which the application of an external stimulus results in the creation of two-phase liquid-liquid systems feasible for the purification step. This approach may also allow the recovery of the target products and phase-forming components, allowing their recyclability. In the past few years, ionic-liquid-based aqueous biphasic systems (IL-based ABS; ternary systems formed by water, ILs, and a salting-out species) have been largely investigated for the separation and purification of a broad range of biocompounds. Nevertheless, their stimuli-responsive behavior and potential as integrated production-separation platforms were scarcely addressed. In this work, novel IL-based ABS and their phases' transitions by changes in pH were addressed to act as integrated production-separation processes in catalytic reactions.

The phase diagrams of a large array of ABS composed of imidazolium-, pyridinium-, piperidinium- and phosphonium-based ILs and the potassium citrate/citric acid buffer (pH values from 9 to 5) were determined. It is shown that pH-driven ABS can be prepared by changing the speciation of the organic salt (potassium citrate) used in the ABS formulation, in which alkaline pH values are favorable to induce two-phase formation. Finally, these systems were applied to produce hydroxymethylfurfural (HMF) from fructose at acidic pH, using ILs as catalysts and in the homogenous regime, and then separated from the unreacted precursor by an increase in the pH and consequent formation of a two-phase system [1]. In summary, reversible IL-based ABS have potential to act as integrated platforms, in which catalytic reactions and separation steps can be carried out sequentially by taking advantage of their switchable behavior.

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FIGURES

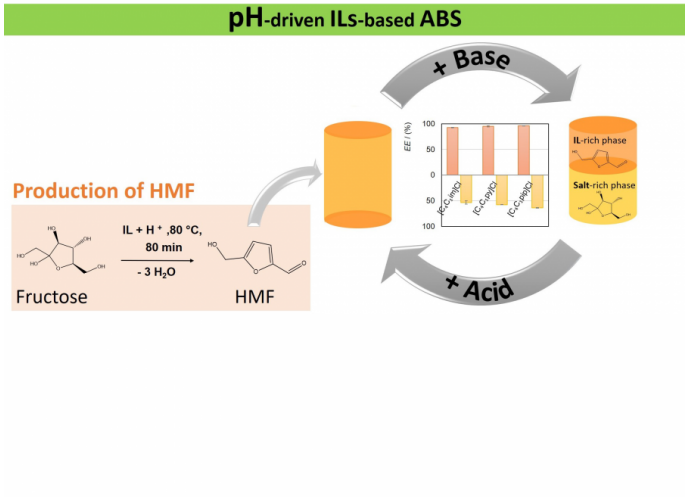

FIGURE 1

Figure 1.

Flowchart of the catalytic integrated process developed.

FIGURE 2

KEYWORDS

Ionic liquids | aqueous biphasic systems | pH-reversible system | hydroxymethylfurfural

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