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Carbonization of lignocellulosic agrowastes in imidazolium-based ionic liquids: an overview and recent advances

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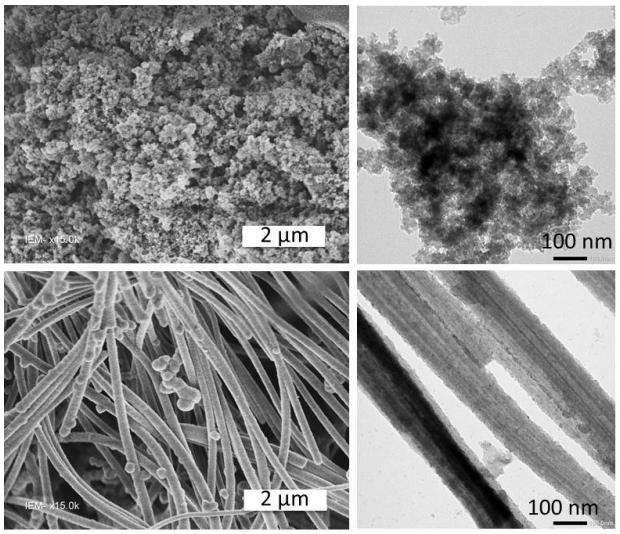
Since 2002 and the first article demonstrating their ability to dissolve cellulose [1], ionic liquids (ILs) have been widely employed in biorefinery, both as derivatizing and nonderivatizing solvents. Beyond dissolution and selective deconstruction, ILs were also employed for the thermochemical conversion of carbohydrates into porous carbonaceous materials [2]. Usually, IL is involved either as a soft-template in water or as a functional solvent playing the role of catalyst and/or porogenic agent. While the first approach falls in the category of hydrothermal carbonization (HTC), the second one can be regarded as ionothermal carbonization (ITC; by analogy with hydrothermal carbonization) yielding ionochars (by analogy with hydrochars). Thus far, such ionothermal treatment has not yet been fully exploited as it has been mainly restricted to monosaccharides [2]. Recently, Xie *et al.* [3] applied the ITC approach to a renewable and low-cost raw material, *i.e.* Jujun grass. The beneficial inputs of ITC in terms of porosity and electrochemical capacitive performance were clearly evidenced, making this two-step approach really promising. More recently, our group provided further insights into biomass-derived ionochars *via* thorough physico-chemical characterizations and comparison with hydrochars analogous. [4, 5] We applied the ionothermal carbonization approach to various polysaccharides and raw lignocellulosic agrowastes, *i.e.* cocoa bean shell, bagasse and risk husk. Various imidazolium-based ILs, including [Bmim]Cl, a well-known commercial ionic liquid, and [Bmim]$FeCl_4$, a Lewis acid IL analogous, were employed as reaction media. The role of both the metal chloride anion and the imidazolium cation over textural properties and particles' morphology was studied (Figure). Subsequent thermal treatments at higher temperatures (*i.e.*, physical activation or pyrolysis) allowed obtaining highly porous carbons with promising properties as sorbents for carbon dioxide capture [4], electrodes for energy storage devices [5] and supports for heterogeneous catalysis.



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