Ionic Liquids in Chemical Synthesis – Progress and Advantages as Compared to Conventional Solvents

Ionic liquids – defined as salts with a melting point below 100 °C – date back to 1914, when Paul Walden reported on $[C_2H_5NH_3]^+[NO_3]^-$, a salt with a melting point of +12 °C. While Walden was surely ahead of his time, ionic liquids made an impressive development during the last 10 years. This is due to their unique portfolio of properties: high temperature stability (in favourable cases up to 400 °C), wide existence of the liquid phase (for some from below room temperature up to 400 °C), low vapour pressure, weekly coordinating cations/anions as constituents, polar but aprotic properties, and a high electrochemical stability (in extreme cases from −4 V to +4 V). Based on the yet available cations and anions, in principle, thousands of different ionic liquids can be established by picking from a plethora of constituents. This allows for a solvent design and a fine-tuning of properties as is hardly possible for any other class of solvents. The term "green designer solvents" has been frequently used in the literature.

Besides all the promised properties and advantages, an essential question for the future perspective of ionic liquids in chemical synthesis is: *What are their unmatched advantages? What can be done with ionic liquids that is not possible with conventional solvents?* Even though the high viscosity and the high costs are certainly still restricting a wider use of ionic liquids, their benefits for organic synthesis and catalysis or as an electrolyte in high-power batteries are highly appreciated by now. Less frequently, ionic liquids are currently used for preparing inorganic compounds although some prominent examples have already indicated the added value. This special issue of *Zeitschrift für Naturforschung B – A Journal of Chemical Sciences* intends to stimulate the use of ionic liquids for chemical synthesis, especially for inorganic compounds by showing some recent impressive results.

In detail, this issue addresses three topics: (*1*) The synthesis of new compounds; (*2*) the synthesis of nanoparticles; (*3*) special properties of ionic liquids and/or of compounds made therein.

Thus, Freudenmann *et al.*, Gjikaj *et al.*, Riedel *et al.*, and Ruck *et al.* report on new clusters, polyhalides and coordination compounds obtained from ionic liquids as well as on the relevant crystal structures.

The synthesis of metal nanoparticles in ionic liquids is comprehensively reviewed by Janiak.

Other articles focus on specific properties and functions of ionic liquids ranging from the biological activity of ionic liquids to materials chemistry and to the physical chemistry of ionic liquid/electrode interfaces. These include the use of surface-active ionic liquids for the extraction of natural products (Bica *et al.*), the antimicrobial activity of imidazolium-based ionic liquids (Giernoth *et al.*), the catalytic epoxidation of olefins in ionic liquids (Kühn *et al.*), the electrochemistry at electrode interfaces (Roling *et al.*), the sorption properties of fluorous ionic liquids to water and hydrofluoroether (Schottenberger *et al.*), and finally the preparation of ionogel fiber mats by electrospinning including an ionic liquid (Taubert *et al.*).

A wealth of literature is presented in these contexts which defines and illustrates the frontier of current research activities.

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