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*in kemijsko tehnologijo*

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*VABILO NA PREDAVANJE  
V OKVIRU DOKTORSKEGA ŠTUDIJA  
KEMIJSKE ZNANOSTI*

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z naslovom:

**IONIC LIQUIDS AS TAILORED MEDIA FOR THE SYNTHESIS  
AND PROCESSING OF ENERGY CONVERSION MATERIALS  
AND SIZE-CONTROLLED SYNTHESIS AND  
STABILISATION OF METAL NANOPARTICLES**

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*Vljudno vabljeni!*

## **Povzetek**

In lithium ion batteries, the electrolyte plays an important role because its physicochemical and electrochemical properties determine their efficiency. Currently, the used organic electrolytes induce difficulties in the manufacturing and the use of the battery (volatile and flammable components). New electrolytes based on molten salts at room temperature, called ionic liquids, are safer potential candidates (low flammability, low vapor pressure, high flash point) with a wide electrochemical window.

In collaboration with the CEA, we work a process to obtain safer and low cost devices based on graphite electrodes, Cgr and IL based electrolyte. Firstly, the design of new IL synthetic routes reducing wastes and cost, together with the investigation of their thermal stability up to combustion and their electrochemical behavior up to overcharge, have been studied. Then, the cyclic performance of these imidazolium based ILs in different experimental conditions has been run. Whatever the conditions, the presence of vinylene carbonate (VC) as additive was crucial for improving the cyclic performance of the Li-ion batteries with Cgr electrodes. Further investigations to determine VC impact onto the solvation and transportation of lithium cation and on the interphase IL/graphite will be discussed.

Imidazolium based ionic liquids (ILs) consist of a continuous 3-D network of ionic channels, coexisting with non polar domains created by the grouping of lipophilic alkyl chains, forming dispersed or continuous microphases. We used these specific solvation properties of ILs, related to this 3-D organisation, to generate and stabilise *in situ* metal nanoparticles (NPs) of a controlled and predictable size.

The phenomenon of crystal growth of NPs (ruthenium, nickel, tantalum) generated *in situ* in ILs from the decomposition of organometallic complexes under molecular hydrogen, is found not only to be controlled by i) the size of non-polar domains, in which the complexes dissolve, but also by ii) the experimental conditions (temperature, stirring) and iii) the nature of the metal and its precursor complex. The key factors influencing the final size (average and distribution) of metallic NPs chemically formed in ILs will be discussed.

Besides, this route has been shown to generate bimetallic nanoparticles upon decomposition of mixtures of precursors, with size, structure and composition controlled, such as Ru@Cu. The mechanism of formation of these nanoalloys, developing a versatile route that could be used to design nanoalloys to fulfill specific applications, e.g., RuNi, RuTa, CuNi, etc

This approach to generate control sized mono or bimetallic nanoparticles has found application in fields such as catalysis and microelectronics.