Biocompatible pillar[5]arene-based ionic liquids containing amino acid fragments as potential water treatment systems

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Ionic liquids (ILs) are a rapidly growing area of technology and materials science due to their unique properties such as low toxicity, high solvating ability, polarity, thermal and electrochemical stability. Their recyclability and adsorption capability promote them as prospective treatment systems. The development of ILs based on the non-toxic biomimetic macrocyclic pillar[5]arene platform will lead to a new generation of materials with programmable properties.

The purpose of this work is the synthesis of new ILs based on decasubstituted pillar[5]arenes with amino acid fragments (glycine, glycylglycine, *L*-alanine, and *L*-phenylalanine); the study of their thermal stability and the effect of substituents and counterions on it, as well as the ability to absorb water-soluble pollutants.

Structure of the obtained ILs was established using ^{1}H, ^{13}C NMR, IR–spectroscopy, MALDI mass spectrometry, elemental analysis. Determination of melting points and simultaneous thermogravimetry (TG) and differential scanning calorimetry (DSC) were used to study thermodynamic characteristics of the ILs. UV spectroscopy was applied to study the interaction and absorption of contaminants by ILs.

Replacement of the bromide anion in the pillar[5]arene structure with NTf_2- resulted in a more significant decrease in melting point (56–88 °C) compared to the PF_6^- anion (86–95 °C), what is logically related to the symmetry and density of the molecular packing. The onset of decomposition of the synthesized compounds was established at 240–300 °C. ILs with *L*-phenylalanine residues showed lower thermal stability and higher melting points compared to smaller fragments (glycine, alanine). The absorption of water-soluble contaminants by ionic liquids was shown to be possible, as expressed by a decrease in optical density.

The obtained results can be applied to the design of new type of non-toxic biomimetic supramolecular materials for sensing, substrate recognition and water treatment.

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