The Effect of Multi-Walled Carbon Nanotubes on Thermal Behavior of 1-Butyl-3-Methylimidazolium Hexafluorophosphate

Tatiana Levitskaya[C], Eugene Paulechka[S] and Andrey Blokhin
Chemistry Faculty and Research Institute for Physical Chemical Problems, Belarusian State University, Minsk, Belarus
levitskaya.tatyana09@gmail.com

The composites of ionic liquids (ILs) and carbon nanomaterials possess a number of features, which make them attractive for various technical applications. The information about interaction of IL ions with solid surfaces is rather contradictory and needs additional investigation. In this work, we report the results of calorimetric study of 1-butyl-3-methylimidazolium hexafluorophosphate $[C_4mim]PF_6$ and its composites containing high mass fraction of stacked-cup multi-walled carbon nanotubes (CNT). Heat capacity of three polymorphs of $[C_4mim]PF_6$ was measured in the temperature range 5 K – T_{fus}, and heat capacity of the liquid phase was measured to 370 K. Parameters of the solid-phase transitions and fusion for various polymorphs were determined. The temperature ranges of stability for various phases were delimited. If a composite contained w(CNT) ≤ 20 %, no statistically significant changes in heat capacity and temperatures of phase transitions of $[C_4mim]PF_6$ compared to pure IL was observed. The results were independent on the fact whether CNT remained hollow or were filled with the liquid. However, at w(CNT) ≥ 80 % we observed the changes in thermal behavior of the composites. The contribution to heat capacity from IL interacting with CNT was identified. This contribution demonstrated gradual increase starting at 190 K, and the resulting heat capacity at high temperatures exceeded that of bulk $[C_4mim]PF_6$.

Acknowledgments

This work was supported by Belarusian State Program of Scientific Research «Chemical technologies and materials, natural resource potential» (grant 1.35).