

Accepted Manuscript

Synthesis and properties of triethanolamine-based salts with mineral and organic acids as protic ionic liquids

M.S. Gruzdev, L.E. Shmukler, N.O. Kudryakova, A.M. Kolker, L.P. Safonova



PII: S0167-7322(17)34579-8
DOI: doi:[10.1016/j.molliq.2017.11.127](https://doi.org/10.1016/j.molliq.2017.11.127)
Reference: MOLLIQ 8243
To appear in: *Journal of Molecular Liquids*
Received date: 29 September 2017
Revised date: 15 November 2017
Accepted date: 16 November 2017

Please cite this article as: M.S. Gruzdev, L.E. Shmukler, N.O. Kudryakova, A.M. Kolker, L.P. Safonova, Synthesis and properties of triethanolamine-based salts with mineral and organic acids as protic ionic liquids. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Molliq(2017), doi:[10.1016/j.molliq.2017.11.127](https://doi.org/10.1016/j.molliq.2017.11.127)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Synthesis and properties of triethanolamine-based salts with mineral and organic acids as protic ionic liquids

M.S. Gruzdev, L.E. Shmukler, N.O. Kudryakova, A.M. Kolker, L.P. Safonova*

G.A. Krestov Institute of Solution Chemistry, Russian Academy of Sciences, 1 Akademicheskaya St., Ivanovo, 153045 Russia

Corresponding author. E-mail address: lps@isc-ras.ru (L.P. Safonova).

Abstract

Seven triethanolammonium (tris(2-hydroethyl)ammonium)-based protic ionic liquids (PILs) and three molten salts were synthesized by proton transfer reaction from carboxylic and inorganic acids to triethanolamine (TEOA). The PILs were characterized by ^1H NMR, ^{13}C NMR, $^1\text{H}/^{15}\text{N}$ NMR and FT-IR spectroscopic methods. The thermal behavior of the synthesized PILs was studied, as well as the temperature dependence of their electric conductivity, viscosity, and their electrochemical stability window (ECW). The melting temperature (T_m) of the salts obtained in this work and of most of the TEOA salts with organic acids reported in literature is within the range of 313 – 373 °C. T_m of most PILs with inorganic acids is higher than 100 °C, besides, they have a narrow temperature range in liquid state. At the temperatures > 90 °C, triethanolammonium trifluoroacetate and nitrate have the highest electric conductivity values ($\sim 10^{-2}$ Ohm $^{-1}\cdot\text{cm}^{-1}$). For the PILs synthesized in this work, just like for TEOA with sulfonic acids, a temperature increase leads to the ECW reduction. The triethanolammonium sulphate salt is the least sensitive to the temperature increase, while in the other PILs the temperature increase from 50 °C to 120 °C makes the ECW 1.4-1.6 times narrower.

Keywords:

Triethanolammonium salts, Ionic liquid, Synthesis, Phase behavior, Conductivity, Electrochemical window

1. Introduction

The last few years have seen a growing interest, both practical and theoretical, in ionic liquids (IL) – salts with the melting temperature below 100 °C. Protic ionic liquids (PILs) formed by the reaction of proton transfer from the Brønsted acid to the Brønsted base are one of the IL subclasses. Their low vapor, significant ionic conductivity, electrochemical stability make these salts applicable to organic synthesis, pharmaceuticals, chromatography and different electrochemical devices. The properties and possible application areas of the PILs obtained so far are analysed in works [1–8]. The number of works devoted to protic ionic liquids is much lower than those on LIs, according to the Ionic Liquids Database – ILThermo. PILs usually have ammonium, imidazolium, pyridinium, phosphonium cations. This work represents the results of studying PILs based on triethanolammonium (tris(2-hydroethyl)ammonium) (TEOA), also called protatranes. The crystal structure of triethanolammonium salts with different anions is analysed in a number of works: [9–18]. In all protatranes, the atom of hydrogen H(N) in the triethanolammonium cation forms trifurcated hydrogen bonds with the oxygen atoms of the hydroxyl groups. At the same time, all three hydrogen atoms of the hydroxyl groups participate in the formation of an intermolecular hydrogen bond with the anion. Quantum-chemical calculations [19] of the geometrical and electronic structures of the complexes formed through interaction of ethanolamines $(\text{CH}_3)_3\text{N}(\text{CH}_2\text{CH}_2\text{OH})_n$ ($n=1-3$) with acids have shown that triethanolamine can form both ionic complexes (BH^+A^-) and H-bonding molecular complexes ($\text{B}\dots\text{HA}$). However, diethanolamine and ethanolamine derivatives form only hydrogen-bonded complexes. A ^{15}N NMR study of 48 equimolar mixtures of Brønsted acids with amines (including triethanolamine) conducted in work [20] has shown that PILs are fully ionized, and their low specific conductivity indicates the formation of neutral ionic pairs. The physicochemical properties (thermal behavior, viscosity, density, specific conductivity, acid-base properties) of PILs with cations $(\text{C}_2\text{H}_5)_3\text{N}(\text{CH}_2\text{CH}_2\text{OH})_n\text{NH}^+$ ($n=1-3$) and different anions were

Download English Version:

<https://daneshyari.com/en/article/7843875>

Download Persian Version:

<https://daneshyari.com/article/7843875>

[Daneshyari.com](https://daneshyari.com)