Ionic Liquids Today

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Issue 3-09, Monday, 21st December, 2009.

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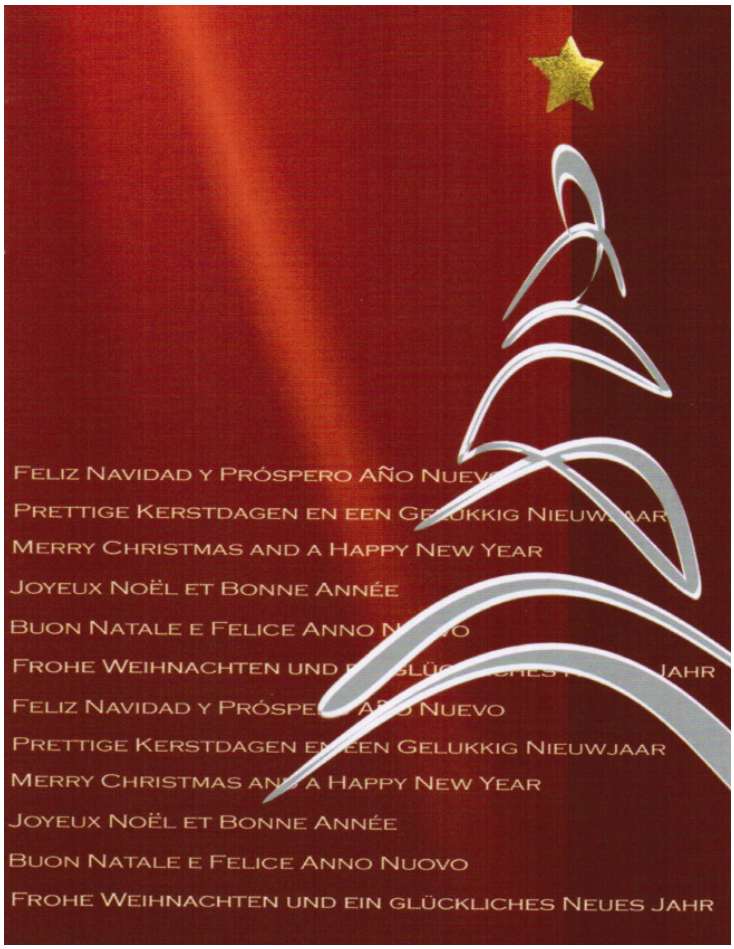


>>> Ionic Liquids in Ionothermal Synthesis

>>> Dye Sensitized Solar Cells: Recent Developments

Content:

1 Editorial

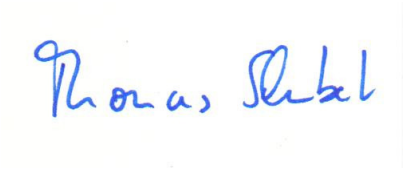
by Thomas J. S. Schubert.

The year 2009 is now close to its end and thus the team of IOLITEC would like to thank our customers for their confidence in our company! In addition, we'd like to thank the whole ionic liquids community for the interesting papers, talks and posters. The fundamental knowledge about ionic liquids increased in an impressive way, and, as a consequence, the extended knowledge led already to a number of interesting applications. I'm sure that ionic liquid research is definitely far away from reaching the "steady state". Probably we have not even seen the end of the beginning!

As a consequence, we will again extend our portfolio in the beginning of 2010. However, if you can't find the product you need, please contact us. We offer custom synthesis at reasonable prices. Furthermore, the continuous optimization of our production processes, but also the production of larger volumes of our best selling products, enables IOLITEC to offer a number of products at better conditions.

Finally, my team and I wish you a good and successful year 2010!

Best regards,



Thomas J.S. Schubert, CEO & Founder, IOLITEC.

2 Ionic Liquids in Ionothermal Synthesis

By Frank M. Stiemke, IOLITEC GmbH.

With this article I'd like to put some light on the following two papers by *Morris et al.*, which focus on ionic liquids (ILs) that are used in "ionothermal syntheses":

E.R. Cooper, C.D. Andrews, P.S. Wheatley, P.B. Webb, P. Wormald, R.E. Morris, *Nature* **2004**, *430*, 1012.

R.E. Morris, *ChemCommun.* **2009**, *17*, 2990.

The synthesis of porous, crystalline solid state materials such as zeolites becomes more and more important e.g. for energy storage applications, as adsorbing media or also as catalysts. In contrast to the usual synthesis by hydrothermal procedures, which are carried out in water under high pressure and by adding an organic template that directs towards the desired structures, ionic liquids can act in the ionothermal synthesis as both: solvent *and* template as a structure directing agent that can be used already in open vessels.

For the synthesis of zeolites a broader definition of ionic liquids is used: Salts, which are liquid at reaction temperatures of 150-200°C. Eutectic mixtures (or DESs: deep eutectic solvents) - because they have got properties that are very similar to ILs – fall of course also under this definition. Ionic liquids are relatively polar solvents, which can dissolve a number of inorganic starting materials almost completely at specific conditions. The interaction between the IL-cation and the (anionic) framework species is the basis for the strong template-effect of IL. The cation of the IL acts as the template, around which the inorganic framework arranges. The synthesis relies on the solvent´s being predominately ionic; adding molecular water (more than 10%) prevents the formation of zeolites due to large hydrogen-bonded clusters. The ionic liquid – framework interactions are disrupted so that there is no interaction at the important crystallization steps any more. In this case the reaction behaves like a hydrothermal one.

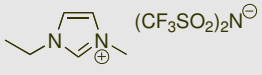
It is not only type and size of the IL-cation, it is also the type of anion that has an effect on the framework: E.g. in the synthesis of aluminophosphates the use the IL 1-ethyl-3-methyl-imidazolium bis(trifluoromethylsulfonyl)imide (EMIM BTA) leads to no absorption of the cation, while the cation is observed if 1-ethyl-3-

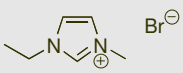
methylimidazolium bromide (EMIM Br) is used. In addition to that, 1:1 mixtures of EMIM Br and EMIM BTA lead to a new type of structure. Furthermore, if chiral anions were used, chiral inorganic structures were observed!

In his fundamental review *Morris* discusses the use of ILs in the ionothermal synthesis and discloses the differences of other synthetic methodologies. He distinguishes between hydrothermal, solvothermal and ionothermal synthesis. The hydrothermal and solvothermal methods use typically molecular solvents, whereas the ionothermal synthesis uses ILs with completely different properties, where the low vapor pressure is surely the most important one.

In this context, since the introduction of the ionothermal synthesis in 2004 the synthesis of aluminophosphate zeolites is surely one of the major breakthroughs: EMIM Br and Choline Chloride / urea (succinic acid, citric acid) eutectic mixtures were used to build up different (interrupted) aluminophosphates zeotype frameworks. The addition of mineralizing agents like fluoride the EMIM Br led to a complete condensation of the mixture. Furthermore, the method has the option to many doping atoms, such as tetrahedral metals Si, Co, Mg etc., can be incorporated by the ionothermal method in these zeolites to improve e.g. their catalytic activity. Zeolite films for anti-corrosion coatings or metal organic frameworks (MOFs) for gas-storage applications are available by this ionothermal method, too.

In conclusion, due to the number of ILs already available and the huge number of IL, that are possible theoretically, the ionothermal synthesis has an enormous potential in inorganic synthesis, leading to a broad variety of new materials.

1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 99%			**REDUCED**
IL-0023-HP	[174899-82-2]	$C_8H_{11}F_6N_3O_4S_2$	MW 391.31
		25 g	55.00 €
		50 g	75.00 €
		100 g	120.00 €
		250 g	260.00 €
		500 g	440.00 €
		1 kg	745.00 €
		5 kg	2'980.00 €

1-Ethyl-3-methylimidazolium bromide, 99%			**REDUCED**
IL-0015-HP	[65039-08-9]	$C_6H_{11}BrN_2$	MW 191.07
		25 g	62.50 €
		50 g	82.50 €
		100 g	110.00 €
		250 g	190.00 €
		500 g	265.50 €
		1 kg	375.00 €
		5 kg	1'295.00 €

3 Ionic liquids as electrolytes for dye-sensitized solar cells (DSSCs)

By Dr. Boyan Iliev, IOLITEC GmbH.

With fuel prices going constantly up and ecologists warning about the effect of increasing CO_2 emissions, industry and research have been looking in the past 15 years for alternatives and above all renewable power sources. Among them are water, wind, biomass, geothermal energy, and solar energy. The global energy consumption in 2006 was estimated at 14 TW. However, in a best case the accessible capacities of water, wind, biomass and geothermal energy could just supply 22 TW in total, which could not cover the estimated global consumption in 2050 which is predicted to be 46 TW. On the other hand, the suns total estimated capacity of 120,000 TW is all that we need. With roughly two thirds of Earth's surface covered with water, a total 36,000 TW are shining onto land and hence one would need only 0.3% of the world's land surface covered by solar cells of 25% efficiency to meet the global energy demand in 2050!

Hence, the sun could be a singular solution to all our future energy needs if we knew how to harvest sun light in a cost-efficient way, which is still not achieved today. The method to do that today is through solar cells. There are a few different types of solar cells commonly used, some of them using semiconductor materials such as silicon for the transformation of light into electricity and others, using organic materials, the so-called dye-sensitized solar cells (DSSCs). They use of a synthetic dye, a nonporous semi-conductor (usually TiO_2) and an electrolyte to convert sunlight into electricity via a complex electrochemical process. Compared to silicon-based solar cells they offer the major advantage of staying functional even under diffuse light. Ionic liquids, with their non-volatility, bright electrochemical windows (ECW), tunable viscosity and conductivity are considered among the most promising electrolytes for such solar cells.

The first who managed to put this idea into practice some 20 years ago was Grätzel[1], from the EPFL in Lausanne, Switzerland, and therefore nowadays these cells are also called Grätzel cells. The most widely used process is based on the I^-/I_3^- redox couple,

[1] B. O'Regan and M. Grätzel, *Nature*, **1991**, 353, 737.

and therefore the main components of the electrolytes are iodine containing ionic liquids, in most cases imidazolium based. The problem with imidazolium iodides is that they have a relatively high viscosity, and, as a consequence, mass-transport limitation problems restrict the use of these ILs as solvents for electrolytes. The effect of the viscosity of IL electrolytes on the performance has been investigated and results show that both the short circuit photocurrent and conversion efficiency increase with decreasing viscosity of the IL. A large progress can be achieved through the use of mixtures of imidazolium iodides and low-viscosity ionic liquids, such as thiocyanates. The viscosity of EMIM SCN is much lower and the diffusion coefficient of triiodide in EMIM SCN is 1.6 times higher than that in the pure PMIM I electrolyte. Other improvements bring different additives which enhance photocurrent or photovoltage. The use of nitrogen-containing heterocycles, such as tert-butylpyridine and *N*-alkylbenzimidazoles, results in an improvement of the open-circuit voltage. It is believed that these compounds, being Lewis bases, are absorbed onto the surface of semiconductors. As a consequence, the conduction band edge of the semiconductor is shifted, thus improving the photovoltage. *N*-Donor additives may also react with components of the electrolytes. For instance, it was recently found that *N*-methylbenzimidazole (NMBI) forms a crystalline product in organic and ionic liquid electrolytes; this crystalline material was identified to be $(NMBI)_6(NMBI^- H^+)_2(I^-)(I_3^-)$.[2]

Another important additive, controlling the self-assembly of the dye molecules, is guanidinium thiocyanate. Guanidinium cations are absorbed together with the dye molecules thus facilitating the formation of a compact monolayer.

IOLITEC tries to use this knowledge to develop enhanced electrolytes showing a better performance in DSSCs. This knowledge was generated in our participation in the COLORSOL® project, funded by the German Ministry for Education and Research, in which the goal was to develop dye sensitized solar cell (DSSC) technologies to a stage close to the application. This new kind of photovoltaic technology has the potential to open up new application fields and future markets for solar energy. Furthermore, the benefit of the DSSC technology in existing photovoltaic application

[2] A. Fischer, H. Pettersson, A. Hagfeldt, G. Boschloo, L. Kloo and M.Gorlov, *Sol. Energy Mater. Sol. Cells*, **2007**, *91*, 1062.

fields should be increased. Another objective was to improve the technology's energy payback time.

Our part in the project was to develop, produce and deliver new electrolytes for these cells. As a result, in the laboratory under direct sunlight, solar efficiency of up to 10.4% have been reached, and in prototypes 4-5%[3].

IoLiTec has had until now 4 ionic liquid based electrolytes as part of its catalogue. Due to the increasing interest in these products, we have decided to add a few new ionic liquid mixtures, already tested in DSSCs and giving very promising results.

IoLi*Lyte*® SP-382 **NEW**
0,15M I_3^- Imidazolium-based Electrolyte
ES-002-HP []

1-Methyl-3-propylimidazolium iodide, Iodine Guanidine thiocyanate *N*-Methylbenzimidazole 3-Methoxyvaleronitril	25 g 50 g 100 g 250 g 500 g 1 kg 5 kg	225.00€ 427.50€ 810.00€ on request on request on request on request

Dalton Trans., 2008, 2655–2666

For example the use of IoLi*Lyte*® SP-382, an 0.15 M I_2 electrolyte in PMIM-I, with Guanidinium Thiocyanate and *N*-Methylbenzimidzole as additives, in combination with the ruthenium complex K19 shown on Fig. 1 has led to an efficiency of 8%, one of the highest published efficiencies.[4]

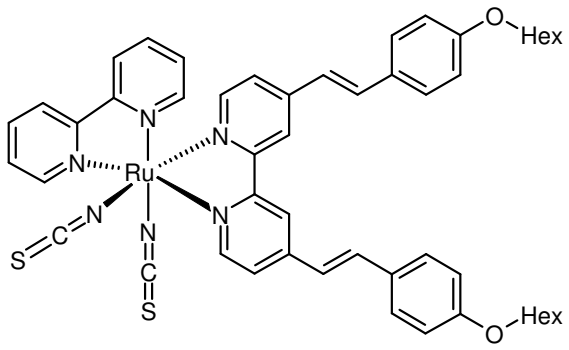


Figure 1 Ruthenium complex used as dye by *Grätzel et al.*

[3] J. M. Kroon, N. J. Bakker, H. J. P. Smit, P. Liska, K. R. Thampi, P.Wang, S.M. Zakeeruddin,M. Grätzel, A. Hinsch, S. Hore, U. Würfel, R. Sastrawan, J.R.Durrant, E. Palomares,H. Pettersson, T.Gruszecki, J. Walter, K. Skupein and G. E. Tulloch, Prog. *Photovolt: Res. Appl.*, 2007, **15**,1

[4] P. Wang, C. Klein, R. Humphry-Baker, S. M. Zakeeruddin and M.Grätzel, *Appl. Phys. Lett.*, 2005, **86**, 123508/1.

Another very interesting electrolyte, IoLi*Lyte*® SP-2164 used by *Kunugi et al.*[5], shows also promising results: Using the N3 Ruthenium salt shown in Fig. 2, the authors have achieved a conversion of 6.7%. This value is very good, considering the low I_2 concentration of only 0.05 M, which is two to four times lower compared to the I_2 concentrations used in other systems, making this electrolyte less prompt to redox influences from outside.

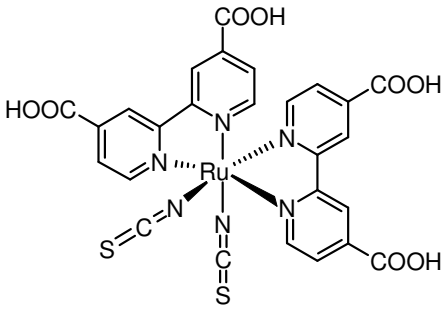


Figure 2

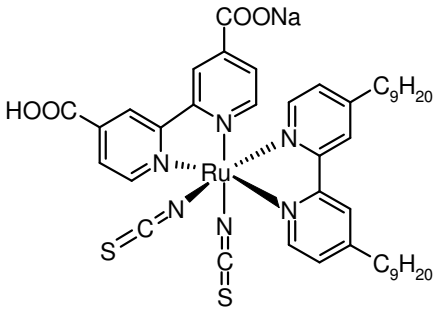


Fig. 3.

Using the dye as shown in Fig. 3 in a cell with IoLiLyte® SP-196 - a low-viscosity melt of EMIM I and DiMIM I, with EMIM SCN to further lower the viscosity and enhance the conductivity of the electrolyte, Grätzel et al. managed to achieve an efficiency of 7.6%. All these electrolytes and more are as of now available in amounts from 25 g to 5 kg from IOLITEC - your partner in Ionic Liquids applications. Get them while they´re hot!

5 *Bull. Chem. Soc. Jpn. Vol.* **2007**, *80*, 2473.

4 Conferences & Fairs

4.1 Wissenschaftsforum Chemie der GdCH Frankfurt am Main, 30 August-2 September, 2009.

by Thomas J. S. Schubert, IOLITEC.

IOLITEC's presentation **"Ionische Flüssigkeiten in der Elektrochemie – innovative Medien für Anwendungen im Bereich Cleantech"** is only available in German language. To get a PDF-version, please contact science@iolitec.de.

The "Wissenschaftsforum Chemie" gives every year an overview about the hottest topics in German chemistry. In a couple of sessions many aspects of recent chemistry were presented and discussed.

In this context, also ionic liquids played a role: In IOLITEC's presentation recent developments in the field of dye sensitized solar cells, Lithium-ion-batteries and supercapacitors were presented.

4.2 Impression from the conference and fair Nanotech 2009 Berlin 28 – 30 September

By Thomas J. S. Schubert.

Please contact science@iolitec.de if you like to receive a PDF-version of IOLITEC's presentation **"Recent Developments in Ionic Liquid Technology for DSSC Application"**.

Nanotechnology and ionic liquids – two fields of emerging technologies where IOLITEC is active and where we predict a number of innovations in the near future. To put more light on the potential synergies between these two technologies, we visited the Nanotech Berlin 2009 in Berlin, where we presented our products at the exhibition.

One of the highlights was surely the talk of Professor Peter Grünberg, the 2007 Nobel Laureat, who gave a deeper insight into his research concerning the GMR-effect, which led to the amazing development of higher storage capacities of hard disks. Other issues that were discussed were e.g. applications of nanotechnology,

like oil discovery, solar energy, or storage of energy, but also the safety of nanoscaled materials. In this context, we presented with great success at our booth at the corresponding fair, our ionic liquid-based dispersion technology.

IOLITEC's presentation at the corresponding conference gave an overview about ionic liquids for the use in DSSC technology.

4.3 Impression from Nanomaterials 2009 Bartholomä, 7-1 September, 2009.

By Boyan Iliev.

Please contact directly Dr. Boyan Iliev (Iliev@iolitec.de) to get a PDF-version of his talk.

The IMinium SAlts conference (or "Tagung" in German language, where the last letter in the abbreviation comes from) took place again in a small picturesque village not far from the town of Aalen. In over 30 oral presentations, spread over 6 sessions and 3 days scientists both from academia and industry from all over the world exchanged results and ideas in the field of iminium salts chemistry.

One of the highlights of the meeting was the lecture of Prof. A. Katritzky (University of Florida, USA) on structure-properties relationships and the computational methods available for the prediction of physical properties. Very popular with the audience and leading to long discussions were also the talks on heterocycle, alkaloid and carbene synthesis.

Iminium salts also play an important role in industrial processes as shown in the lectures by Syngenta, BASF, Bayer and last but not least IoLiTec. We showed that ionic liquids, most of which are perfect examples of iminium salts, can be used not only as catalysts and solvents, but also for complicated electrochemical or thermal applications, such as dye-sensitzed solcar cells (DSSC) or sorption cooling.

4.4 Intertech PIRA Ionic Liquids Summit 2009 Miami, USA, 18-19 November, 2009.

By Tom F. Beyersdorff.

Please contact directly Dr. Tom Beyersdorff (beyersdorff@iolitec.de) to get a PDF-version of his talks.

After the successful conferences in 2006 and 2007, IntertechPira organized the Ionic Liquids Summit for the third time. The conference took place at the Courtyard by Marriott hotel in Miami Beach/USA from November 18-19, 2009 and was chaired by Dr. Robin Rogers and myself.

The conference focused on electrochemical and alternative energy applications as well as the latest in market developments.

Almost 30 participants from industry and academia attended the conference and listened to presentations on recent research in the field of ionic liquids.

In his opening presentation Dr. Rogers gave an overview on ionic liquids and the development of the research field in the last two decades. I myself discussed during my presentation the hurdles of their commercialization from the position of a start-up company.

Further presentations during the conference focused on toxicity studies, dye-sensitized solar cells, lithium and lithium-ion batteries, lubricants, prediction of physicochemical properties, task-specific ionic liquids for CO_2 absorption and many related aspects.

Several coffee breaks and the evening reception provided the opportunity for making up new contacts, networking and an intensive exchange of ideas.

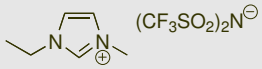
A general conclusion of the conference is, that there are in fact no hurdles for the commercialisation of ionic liquids but one – to start research with ionic liquids.

We would like to thank the organisers of the conference for their and for choosing such a beautiful place as Miami Beach.

5 Special Offers

1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 99%

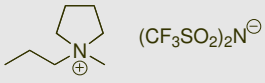
IL-0023-HP [174899-82-2] $C_8H_{11}F_6N_3O_4S_2$ MW 391.31



25 g	47.50 €
50 g	65.00 €
100 g	102.50 €
250 g	220.00 €
500 g	375.00 €
1 kg	635.00 €
5 kg	2'685.00 €

1-Methyl-1-propylpyrrolidinium bis(trifluoromethylsulfonyl)imide, 99%

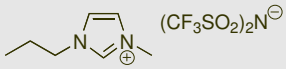
IL-0044-HP [223437-05-6] $C_{10}H_{18}F_6N_2O_4S_2$ MW 408.38



25 g	55.00 €
50 g	72.50 €
100 g	107.50 €
250 g	215.00 €
500 g	350.00 €
1 kg	625.00 €
5 kg	2'645.00 €

1-Methyl-3-propylimidazolium bis(trifluoromethylsulfonyl)imide, 99%

IL-0024-HP [216299-72-8] $C_9H_{13}F_6N_3O_4S_2$ MW 405.34



25 g	70.00 €
50 g	90.00 €
100 g	157.50 €
250 g	327.50 €
500 g	555.00 €
1 kg	945.00 €
5 kg	4'230.00 €

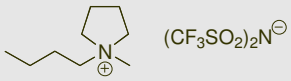
Butyltrimethylammonium bis(trifluoromethylsulfonyl)imide, 99%

IL-0032-HP [258273-75-5] $C_9H_{18}F_6N_2O_4S_2$ MW 396.37

25 g	65.00 €
50 g	82.50 €
100 g	150.00 €
250 g	290.00 €
500 g	475.00 €
1 kg	845.00 €
5 kg	3'865.00 €

1-Butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide, 99%

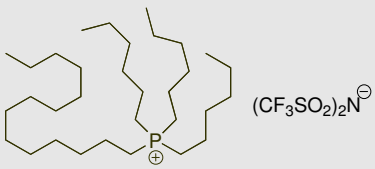
IL-0035-HP [223437-11-4] $C_{11}H_{20}F_6N_2O_4S_2$ MW 422.41



25 g	55.00 €
50 g	72.50 €
100 g	100.00 €
250 g	210.00 €
500 g	337.50 €
1 kg	615.00 €
5 kg	2'610.00 €

Trihexyltetradecylphosphonium bis(trifluoromethylsulfonyl)imide, >98%

IN-0021-HP [460092-03-9] $C_{34}H_{68}F_6NO_4PS_2$ MW 763.24

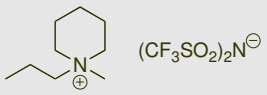


25 g	57.50 €
50 g	72.50 €
100 g	132.50 €
250 g	310.00 €
500 g	590.00 €
1 kg	1'120.00 €
5 kg	4'730.00 €

A product of Cytec Industries Inc. (CYPHOS® IL-109)

1-Methyl-1-propylpiperidinium bis(trifluoromethylsulfonyl)imide, 99%

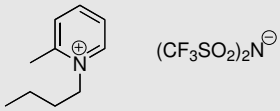
IL-0045-HP | [608140-12-1] | $C_{11}H_{20}F_6N_2O_4S_2$ | MW 422.41



25 g	60.00 €
50 g	77.50 €
100 g	127.50 €
250 g	265.00 €
500 g	470.00 €
1 kg	845.00 €
5 kg	3'585.00 €

1-Butyl-2-methylpyridinium bis(trifluoromethylsulfonyl)imide, 99%

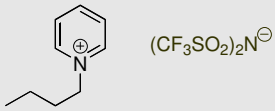
IL-0228-HP | [384347-09-5] | $C_{12}H_{16}F_6N_2O_4S_2$ | MW 430.39



25 g	95.00 €
50 g	125.00 €
100 g	210.00 €
250 g	450.00 €
500 g	760.00 €
1 kg	1'230.00 €
5 kg	5'490.00 €

1-Butylpyridinium bis(trifluoromethylsulfonyl)imide, 99%

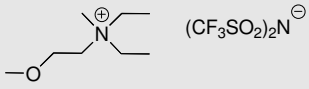
IL-0213-HP | [187863-42-9] | $C_{11}H_{14}F_6N_2O_4S_2$ | MW 416.36



25 g	90.00 €
50 g	120.00 €
100 g	205.00 €
250 g	430.00 €
500 g	735.00 €
1 kg	1'245.00 €
5 kg	5'935.00 €

***N,N*-Diethyl-*N*-methyl-*N*-(2-methoxyethyl) ammonium bis(trifluoromethylsulfonyl)imide, 99%**

IL-0116-HP | [464927-84-2] | $C_{10}H_{20}F_6N_2O_5S_2$ | MW 426.40

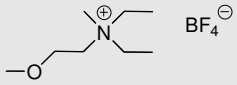


25 g	185.00 €
50 g	337.50 €
100 g	640.00 €
250 g	1'515.00 €
500 g	2'845.00 €
1 kg	on request
5 kg	on request

Only available in the European Union and the USA. Produced by Nisshinbo Industries.

***N,N*-Diethyl-*N*-methyl-*N*-(2-methoxyethyl) ammonium tetrafluoroborate, 99%**

IL-0123-HP | [464927-72-8] | $C_8H_{20}BF_4NO$ | MW 233.06

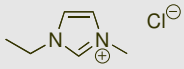


25 g	137.50 €
50 g	247.50 €
100 g	427.50 €
250 g	887.50 €
500 g	1'687.50 €
1 kg	on request
5 kg	on request

Only available in the European Union and the USA. Produced by Nisshinbo Industries.

1-Ethyl-3-methylimidazolium chloride, >98%

IL-0093-HP | [65039-09-0] | $C_6H_{11}ClN_2$ | MW 146.62

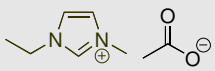


25 g	67.50 €
50 g	80.00 €
100 g	100.00 €
250 g	215.00 €
500 g	370.00 €
1 kg	625.00 €
5 kg	2'810.00 €

Filled in as crystaline solid!

1-Ethyl-3-methylimidazolium acetate, >95%

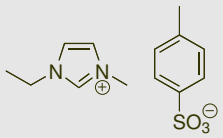
IL-0189-TG | [143314-17-4] | $C_8H_{14}N_2O_2$ | MW 170.21



25 g	55.00 €
50 g	65.00 €
100 g	97.50 €
250 g	150.00 €
500 g	225.00 €
1 kg	335.00 €
5 kg	1'425.00 €

1-Ethyl-3-methylimidazolium tosylate, 99%

IL-0008-HP | [328090-25-1] | $C_{13}H_{18}N_2O_3S$ | MW 282.36



25 g	45.00 €
50 g	52.50 €
100 g	95.00 €
250 g	187.50 €
500 g	335.00 €
1 kg	575.00 €
5 kg	2'415.00 €

All special offers are valid until January 31st, 2010.
Special offers can not be combined with discounts granted for catalogue products.

6 Selected Applications of Ionic Liquids

By Thomas J. S. Schubert.

Polymer-ionic liquid gels for enhanced gas transport

S. U. Hong, D. Park, Y. Koa, I. Baekb, *Chem. Commun.,* **2009**, 7227–7229.

The separation of gases by using polymeric membranes is in general of great interest. In their paper the authors presented a method for the preparation of a polymer-ionic liquid gel film using 1-ethyl-3-methyl-imidazolium tetrafluoroborate and poly(vinylidene fluoride)-hexafluoropropyl copolymer as host polymer.

The synthesized membranes were used to separate CO_2 from N_2. By measuring the permeate concentration, they were able to determine the selectivity of the membrane. It was found that a selectivity (CO_2/N_2) of up to 60 was possible by using an RTIL:polymer ratio of 2:1.

These results show clearly that polymer-ionic liquid composites can be used efficiently in membrane technology.

A new class of double alkyl-substituted, liquid crystalline imidazolium ionic liquids—a unique combination of structural features, viscosity effects, and thermal properties

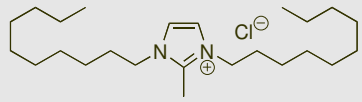
X. Wang, F. W. Heinemann, M. Yang, B. U. Melcher, M. Fekete, A.-V. Mudring, P. Wasserscheid, K. Meyer, *Chem. Commun.*, **2009**, 7405.

That some ionic liquids can show a liquid crystalline behavior is in fact not surprising, and was described first by *Seddon et al.* in 1998. In this paper the authors present with 1,3-Didodecyl-imidazolium tetrafluoroborate and the corresponding perchlorate ionic liquid two materials, that show a thermotropic liquid crystalline and also a strong non-Newtonian behavior.

From our point of view this field of research is still underestimated, since we found at our labs with 1,3-didecyl-2-methyl-imidazolium chloride a compound that also showed some interesting properties. In 2010, IOLITEC plans to extend the portfolio with similar substances. Please ask our colleagues also for custom synthesis!

1,3-Didecyl-2-methylimidazolium chloride, >98%

IL-0046-HP [70862-65-6] $C_{24}H_{47}ClN_2$ MW 399.10



25 g	145.00 €
50 g	190.00 €
100 g	255.00 €
250 g	545.00 €
500 g	920.00 €
1 kg	1'565.00 €
5 kg	on request

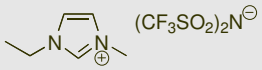
Template-assisted electrodeposition of Si_xGe_{1-x} nanowires with varying length and composition from two different ionic liquids

R. Al-Salman, F. Endres, *J. Mater. Chem.* **2009**, *19*, 7228

It becomes more and more established that ionic liquids have a large influence on structure modifications if they are used as solvents in nanoparticle synthesis or in electrodeposition. In their paper, Endres and Al-Salman demonstrated that Si_xGe_{1-x} can be deposited as nanowires from the ionic liquids 1-ethyl-3-methyl-imidazolium bis(trifluoromethylsulfonyl)imide and 1-butyl-1-methyl-pyrrolidinium bis(trifluoro-methylsulfonyl)imide. Interestingly, at the same conditions significant longer nanowires were achievedionic liquids with the 1-ethyl-3-methyl-imidazolium cation, which is another example for the structure directing effect of ionic liquids.

1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 99%

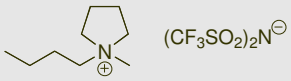
IL-0023-HP [174899-82-2] $C_8H_{11}F_6N_3O_4S_2$ MW 391.31



25 g	47.50 €
50 g	65.00 €
100 g	102.50 €
250 g	220.00 €
500 g	375.00 €
1 kg	635.00 €
5 kg	2'685.00 €

1-Butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide, 99%

IL-0035-HP [223437-11-4] $C_{11}H_{20}F_6N_2O_4S_2$ MW 422.41



25 g	62.50 €
50 g	85.00 €
100 g	120.00 €
250 g	245.00 €
500 g	397.50 €
1 kg	725.00 €
5 kg	2'895.00 €

Ammonia Borane Hydrogen Release in Ionic Liquids

D. W. Himmelberger, L. R. Alden, M. E. Bluhm, L. G. Sneddon, *Inorg. Chem.* **2009**, *48,* 9883.

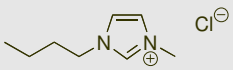
The storage of energy produced from renewable energy sources in general is still a challenge and is in the focus of numerous research projects worldwide. In this context, the use of hydrogen as alternative energy carrier is of great importance in the future. In the case of chemical hydrogen storage ammonia borane is one of the most promising candidates, since 19.6 wt% of H_2 can be stored in 1 eq. Since the safety is of course an important issue, ionic liquids have compared with molecular solvents the advantage of being non-volatile.

Sneddon and co-workers reported a method for the safe and controlled release of H_2 from ammino borane by using ionic liquids: In their paper they presented a study, where a set of different ionic liquids was tested. Those ionic liquids, which showed the best performance in terms of the H_2-release, were BMIM Cl, BDiMIM Cl, BMIM BF_4, and DiMIM MeSO4.

IOLITEC's invites interested researchers to discuss this interesting topic (science@iolitec.de).

1-Butyl-3-methylimidazolium chloride, 99%

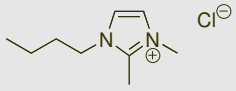
IL-0014-HP [79917-90-1] $C_8H_{15}ClN_2$ MW 174.67



25 g	47.50 €
50 g	65.00 €
100 g	85.00 €
250 g	150.00 €
500 g	207.50 €
1 kg	290.00 €
5 kg	1'015.00 €

1-Butyl-2,3-dimethylimidazolium chloride, 99%

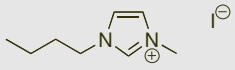
IL-0056-HP [98892-75-2] $C_9H_{17}ClN_2$ MW 188.70



25 g	75.00 €
50 g	100.00 €
100 g	132.50 €
250 g	280.00 €
500 g	475.00 €
1 kg	805.00 €
5 kg	3'220.00 €

1-Butyl-3-methylimidazolium iodide, >98%

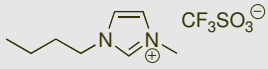
IL-0051-HP [65039-05-6] $C_8H_{15}IN_2$ MW 266.12



25 g	80.00 €
50 g	107.50 €
100 g	170.00 €
250 g	340.00 €
500 g	545.00 €
1 kg	870.00 €
5 kg	on request

1-Butyl-3-methylimidazolium trifluoromethanesulfonate, 99%

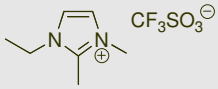
IL-0013-HP [174899-66-2] $C_9H_{15}F_3N_2O_3S$ MW 288.29



25 g	80.00 €
50 g	127.50 €
100 g	230.00 €
250 g	415.00 €
500 g	750.00 €
1 kg	1'250.00 €
5 kg	5'285.00 €

1-Ethyl-2,3-dimethylimidazolium trifluoromethanesulfonate, 99%

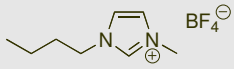
IL-0002-HP [174899-72-0] $C_8H_{13}F_3N_2O_3S$ MW 274.26



25 g	187.50 €
50 g	250.00 €
100 g	372.50 €
250 g	837.50 €
500 g	1'507.50 €
1 kg	2'710.00 €
5 kg	on request

1-Butyl-3-methylimidazolium tetrafluoroborate, 99%

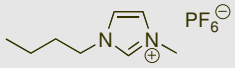
IL-0012-HP [174501-65-6] $C_8H_{15}BF_4N_2$ MW 226.02



25 g	40.00 €
50 g	57.50 €
100 g	92.50 €
250 g	145.00 €
500 g	250.00 €
1 kg	450.00 €
5 kg	1'695.00 €

1-Butyl-3-methylimidazolium hexafluorophosphate, 99%

IL-0011-HP [174501-64-5] $C_8H_{15}F_6N_2P$ MW 284.18



25 g	40.00 €
50 g	60.00 €
100 g	95.00 €
250 g	180.00 €
500 g	325.00 €
1 kg	585.00 €
5 kg	2'225.00 €

1,3-Dimethylimidazolium methyl sulfate, 99%

IL-0243-HP [97345-90-9] $C_6H_{12}N_2O_4S$ MW 208.24

25 g	47.50 €
50 g	70.00 €
100 g	100.00 €
250 g	160.00 €
500 g	270.00 €
1 kg	360.00 €
5 kg	1'440.00 €

Effects of Ionic Liquids on the Characteristics of Synthesized Nano Fe(0) Particles

Y. Zhao, G. Cui, J. Wang, M. Fan, *Inorg. Chem.* **2009**, *48,* 10435.

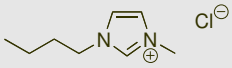
IOLITEC's intention is to combine ionic liquids and nanomaterials for their use in many emerging technologies. In this context, it is well-known that ionic liquids are e.g. suitable media for the synthesis of nanomaterials and –particles, in particular. It was shown that the structure, the size, and the size distribution can be influenced by the use of different types of ionic liquids.

In their paper *Wang et al.* demonstrated that Fe(0) particles can be prepared by reduction of $FeCl_3$ with $NaBH_4$ in aqueous solutions of ionic liquids. To show the influence of the anion, they used the 1-butyl-3-methyl-imidazolium cation in combination with Cl, Br, BF_4 and PF_6, while to demonstrate the influence of the cation, they used 1-alkyl-3-methylimidazolium tetrafluoroborates (alkyl: butyl, hexyl, octyl). The smallest particles were synthesized in 1-butyl-3-methyl-imidazolium PF_6, the largest in the corresponding chloride. In the series of the tetrafluorborates, they observed the smallest particles by using the octyl-derivative.

Nevertheless, using this comparable easy reaction system, other types of ionic liquids could or should be used as well.

1-Butyl-3-methylimidazolium chloride, 99%

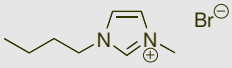
IL-0014-HP [79917-90-1] $C_8H_{15}ClN_2$ MW 174.67



25 g	47.50 €
50 g	65.00 €
100 g	85.00 €
250 g	150.00 €
500 g	207.50 €
1 kg	290.00 €
5 kg	1'015.00 €

1-Butyl-3-methylimidazolium bromide, 99%

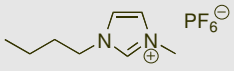
IL-0037-HP [85100-77-2] $C_8H_{15}BrN_2$ MW 219.12



25 g	45.00 €
50 g	60.00 €
100 g	80.00 €
250 g	140.00 €
500 g	197.50 €
1 kg	275.00 €
5 kg	962.50 €

1-Butyl-3-methylimidazolium hexafluorophosphate, 99%

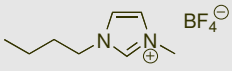
IL-0011-HP [174501-64-5] $C_8H_{15}F_6N_2P$ MW 284.18



25 g	40.00 €
50 g	60.00 €
100 g	95.00 €
250 g	180.00 €
500 g	325.00 €
1 kg	585.00 €
5 kg	2'225.00 €

1-Butyl-3-methylimidazolium tetrafluoroborate, 99%

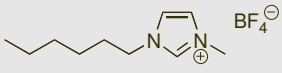
IL-0012-HP [174501-65-6] $C_8H_{15}BF_4N_2$ MW 226.02



25 g	40.00 €
50 g	57.50 €
100 g	92.50 €
250 g	145.00 €
500 g	250.00 €
1 kg	450.00 €
5 kg	1'695.00 €

1-Hexyl-3-methylimidazolium tetrafluoroborate, 99%

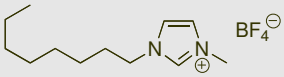
IL-0019-HP [244193-50-8] $C_{10}H_{19}BF_4N_2$ MW 254.08



25 g	50.00 €
50 g	67.50 €
100 g	105.00 €
250 g	230.00 €
500 g	415.00 €
1 kg	740.00 €
5 kg	2'995.00 €

1-Methyl-3-octylimidazolium tetrafluoroborate, 99%

IL-0021-HP [244193-52-0] $C_{12}H_{23}BF_4N_2$ MW 282.13



25 g	57.50 €
50 g	85.00 €
100 g	125.00 €
250 g	265.00 €
500 g	480.00 €
1 kg	795.00 €
5 kg	3'165.00 €

7 Community

by Tom F. Beyersdorff, Frank M. Stiemke & Thomas J.S. Schubert

Upcoming Exhibitions and Conferences:

NanoTech 2010, Tokyo, Japan, February 17-19, 2010
http://www.nanotechexpo.jp/en/

IOLITEC will be present as part of the German pavilion, East Hall 6, booth F-14-2. Dr. Frank Stiemke will give a talk and present a poster on our developments in synthesis and dispersion of nano-particles with the help of ionic liquids.

Informex 2010, San Francisco/USA, February 16-19, 2010
http://www.informex.com/home

IOLITEC will participate in Informex 2010 with booth 318.

239th American Chemical Society National Meeting, San Francisco/ USA, March 21-25, 2010
http://www.chemistry.bnl.gov/SciandTech/PRC/physchemil2010.html

Edward W. Castner, Jr. (Rutgers University) and James F. Wishart (Brookhaven National Laboratory) are organizing the "Physical Chemistry of Ionic Liquids" Symposium at the 239th ACS National Meeting. The symposium will assemble an international array of speakers to discuss ionic liquids in the context of their heterogeneous environments, solvation, dynamics and transport, interfacial properties, and the fundamentals of chemical reactivity in these systems.

ChemSpec Europe 2010, Berlin/Germany, June 9-10, 2010
http://www.chemspeceurope.com/

You can meet IOLITEC at ChemSpec Europe at booth J5 in hall 22. Furthermore, Dr. Thomas Schubert will give a talk in the exhibitor´s showcase on June 9, 2010 at 11:00 a.m.

Please contact us in advance if you want to meet IOLITEC´s representatives at any of these events (info@iolitec.de) we would be glad to schedule an appointment with you.

EUCHEM Conference on Molten Salts and Ionic Liquids 2010,

Bamberg/Germany, March 14-19, 2010

http://events.dechema.de/en/euchem2010

The EUCHEM 2010 Conference on Molten Salts and Ionic Liquids will again offer the opportunity for scientists to discuss latest developments in their ionic media research. The scientific topics will include fundamental and theoretical aspects, physico-chemical properties and mechanistic studies as well as all kind of application-driven and applied research.

The scientific programme will consist of a plenary lecture after the opening ceremony, 9 keynote lectures, 45 oral contributions and two consecutive posters sessions.

Nanotech 2010,

Anaheim/USA, June 21-25, 2010

http://www.techconnectworld.com/Nanotech2010/

Pease keep us informed about other interesting events we could highlight in Ionic Liquids Today.

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