Ionic Liquids Today

www.iolitec.com

Issue No. 17, Tuesday, November 25th, 2014.

>>> Custom Synthesis & Development @ IOLITEC

>>> 3MTM-Fluids @ IOLITEC

Content:

1 Editorial

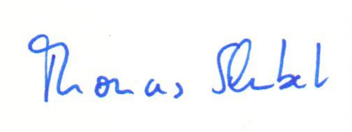
In 2014 we celebrate the 100th anniversary after the first description of an ionic liquid by Paul Walden. In 2014 also our company has celebrated its 10th anniversary of selling ionic liquids to the R&D-market. Looking back on our short, but intensive history, we learned over the past years a lot about ionic liquids, about their visions and their applications, but we also learned that there are some fields where they didn't meet all our expectations.

This should not sound too pessimistic, since I can promise you that there are today many examples of commercialized products, so ionic liquids will *definitely not* end up as a lab curiosity! Even if we simply summarize what engineers, scientists, and of course we, but also other companies have reached so far, it is not arrogant to say that ionic liquids tell already a story of success!

Next to academic research a lot of R&D is going on at companies worldwide. There are already a couple of applications realized, being (sometimes) not identified by the scientific radar. Finally, I'm optimistic that 2015 will bring again numerous breakthroughs in different fields of technology!

In the name of my team I would like to thank all of our customers, partners, and generally all ionic liquids enthusiasts for the good co-operation and to wish you all the best for 2015!

Sincerely Yours,



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

2 News from IOLITEC Inc.

By Frank M. Stiemke

Up to date the year 2014 has been quite a busy year for me at IOLITEC Inc. and I would like to take this opportunity to thank our customers in North America for their continued business with us. After discussions with you, our customers, we have inter alia introduced several new products at IOLITEC Inc.:

Now the so-called **"optical pure" ionic liquids** are available in USA on request! These ILs will allow performing spectroscopic experiments without (or reduced) interfering of the IL-solvent with the species of interest.

Beside this, IOLITEC Inc. has continued to stock larger amounts of our **standard ultra-pure** (=colorless) versions of the most popular Ionic Liquids in order to further cut lead times. It is our goal to keep the lead time as short as possible, even during times, in which the IOLITEC Inc's office is unattended due to business travel.

Furthermore, **IOLITEC Inc. has signed an agreement with Streamline Automation LLC about the distribution of a so called "Algae-Kit"**. This kit allows customers to lyse algae and separate the oil. The kit includes an ionic liquid-based lysis solution and a separating solution as well as instructions on how to perform the experiments. Two sizes of the kit are currently available, which allow the processing of 3 grams of algae paste or 30 grams of algae paste. For more information, please visit our website http://www.iolitec-usa.com/Ionic-Liquids/algae-oil-lysis-and-extraction-kit.html or inquire by email.

In addition to that, IOLITEC Inc. will continue to broaden its USA-product portfolio by distributing **substituted silanes**. For available products, please visit our webpage.

As many of you might already know, IOLITEC offers **custom synthesis** of all patent free ionic liquids in the USA too and I would be glad to receive your inquiries for non-catalog products, too.

And don't forget this year's "**Black Friday sale**"! (See separate mailing or inquire for discount details.)

Please direct inquiries to:
Dr. Frank M. Stiemke
Email: stiemke@iolitec.com
Phone: 1-205-348-2831
www.iolitec-usa.com

3 Novel High Tech Fluids by 3M

By Bettina Blumenröder.

3M and IOLITEC expand their fruitful cooperation on 3MTM NovecTM Products

Since the beginning of 2012 IOLITEC GmbH has been an authorized dealer for 3MTM NovecTM and FluorinertTM products. In 2013 we have broadened the range of high tech fluids. In addition to five different NovecTM liquids (7000, 7100, 7200, 7300 and 7500) and five different FluorinertTM materials (FC-40, FC-43, FC-72, FC-770 and FC-3283) now our portfolio comprises five more 3MTM Novec Engineered Fluids, NovecTM 71DA, NovecTM 71DE, NovecTM 72DA, NovecTM 72DE and NovecTM 71IPA.

3MTM NovecTM Engineered Fluids do have some outstanding properties that fit perfectly with today´s important demands: low environmental impact and good performance. Combining zero ozone depletion potential, low global warming potential, low toxicity and non-flammability they can be used safely in a wide range of applications. The main applications are in the field of thermal management, as solvents for coating material and lubricants as well as for precision cleaning. They can be used "neat" or as an azeotropic blend of NovecTM and some additives according to specific purposes.

The following pages will give a short overview of precision and electronics cleaning with 3MTM Engineered Fluids. Due to the wide field of various types of soils to be cleaned, it is difficult to recommend just one single cleaning solvent. Depending on the type of specific soils different products are suggested.

Cleaning with 3MTM Engineered Fluids[1,2]

Light-duty cleaning

To remove light hydrocarbon and silicone oils 3MTM NovecTM materials can be used neat. Being highly-fluorinated materials themselves, NovecTM fluids are ideal for cleaning halogenated oils and greases, like the rule of thumb "like dissolves alike". Besides cleaning dry etcher parts, hard drive components and assemblies it is also possible to remove particulates from plastics. Because of Novec™ materials´ low heat of vaporization the solvent evaporates quickly without leaving any residue. For soils, such as light oils, halogenated compounds, particulates and release agents various Novec™ fluids are available.

Soiling to be removed	***Suggested Novec™ Products***
Light oils	3M™ Novec™ Engineered Fluid 7100
Halogenated compounds	3M™ Novec™ Engineered Fluid 7200
Particulates	3M™ Novec™ Engineered Fluid 71IPA
Release agents	

Typical applications: hard disk drive components, wafer carriers, fiber optic connectors

Table 1. Typical physical Data of 3M™ Novec™ Engineered Fluids

Novec™ Fluids	unit	Novec 7100	Novec 7200	Novec 71IPA
Boiling point	°C	61	76	54.8
Freeze point	°C	-135	-138	-42[1]
Liquid density	g/mL	1.52	1.43	1.48
Surface tension	mN/m	13.6	13.6	14.5
Vapor pressure	mm Hg	202	109	207
Viscosity	cp	0.61	0.61	0.75
Heat of Vaporization[2]		30	30	39.5

[1)] Critical solution temperature [2)] cal/g @ boiling point (all values at 25°C unless noted)

Medium- to heavy-duty cleaning

3M™ Novec™ Engineered Fluids (71DA, 71DE, 72DA, 72DE) are azeotropes or azeotropic blends of pure Novec™ material mixed with one or more additives. Azeotropes possessing the unique advantage to evaporate at their specific boiling point without changing their composition and so make a contribution to process reliability and control. Additionally, these Novec™ fluids have a much higher dissolving power compared to the neat 3M™ Novec™ Engineered Fluids 7100 and 7200 and therefore are ideally suited for cleaning soils ranging from hydrocarbons and silicone oils to grease. Due to their outstanding physical properties such as fairly high density, low viscosity, low surface tension Novec™ fluids are powerful cleaning solvents, also for cleaning flux residues and low melting point waxes.

Soiling to be removed	**Suggested Novec™ Products**
Medium- to heavy-duty oils	3M™ Novec™ Engineered Fluid 71DA
Lubricants	3M™ Novec™ Engineered Fluid 71DE
Low MP waxes	3M™ Novec™ Engineered Fluid 72DA
Polishing fluids	3M™ Novec™ Engineered Fluid 72DE
Buffing compounds	
RMA flux	
No Clean Flux	

Typical applications: Relays, flip chip assemblies

Table2. Typical physical data of 3M™ Novec™ Engineered Fluids

Novec™ Fluids	unit	Novec 71DA	Novec 71DE	Novec 72DA	Novec 72DE
Boiling point	°C	40	41	44	43
Freeze point	°C	-29	-24	-38	N/A
Liquid density	g/mL	1.33	1.37	1.27	1.28
Surface tension	mN/m	16.4	16.6	18	19
Vapor pressure	mm Hg	381	383	360	350
Viscosity	cp	0.45	0.45	0.40	0.45
Heat of Vaporization[1]		50	48	60	52

1) cal/g @ boiling point (all values at 25°C unless noted)

Co-solvent and Bi-solvent system

Besides before mentioned removal of light-duty and medium- to heavy-duty soils with 3M™ Novec™ Engineered Fluids, these materials are also capable to clean the most challenging soils, such as heavy-weight oils, greases and waxes. This is done by using the so called co-solvent process or co-solvent system. In this procedure pure Novec™ fluids, normally Novec™ 7100, 7200 or 71IPA, are combined with organic solvents. The organic solvent enhances the cleaning power of the system while Novec™ Fluids rinse both the solvating agent and soils from the surface of the parts to be cleaned. Closely related to this system is the so called bi-solvent process.

Both fluids, 3M™ Novec™ and the organic solvent, are not used as combination of both as before but in single sequential steps.

Soiling to be removed	***Suggested Novec™ Products***
Heavy-weight oils	3M™ Novec™ Engineered Fluid 7100
greases	3M™ Novec™ Engineered Fluid 7200
waxes	3M™ Novec™ Engineered Fluid 71IPA

Typical applications: bearings, avionics, printed circuit board assemblies, optical components

3M™ Novec™ and Fluorinert™ Liquids available at IoLiTec at a glance

Novec™ 7000	FC-40	Novec™ 71DA
Novec™ 7100	FC-43	Novec™ 71DE
Novec™ 7200	FC-72	Novec™ 72DA
Novec™ 7300	FC-770	Novec™ 72DE
Novec™ 7500	FC-3283	Novec™ 71IPA

All liquids are available from 100g up to 4.5/5kg and in small bulk quantities. For further information please have a closer look into our Key Intermediates list available for download on our homepage: http://www.iolitec.de/Download-document/988-Productlist_KI_2013.html

For detailed information on 3M™ Novec™ Engineered Fluids please see following brochures:

1) “Die Wissenschaft der Präzisions- & Elektronikreinigung” by 3M™
2) „The science of precision & electronics cleaning“ by 3M™

Also see: http://www.youtube.com/watch?v=eB2EN8PPgDE&list=PL024647A48C5E7E9A

4 Custom Development and Custom Synthesis @ IOLITEC

By Boyan Iliev & Thomas J. S. Schubert

4.1 Introduction

Ionic liquids still gain more and more popularity, as witnessed by the number of IL-related publications, which has reached up the number of 50'000 in 2013. Though the theoretical number might be extraordinary high, the number of published ILs mentioned in the scientific literature is hardly more than 2'000.

Although the overall number of useful materials will be surely at least one magnitude smaller, the number of theoretically possible ionic liquids that can be made through a random anion/cation combination is of course finally far above 2'000. So far we believe to cover with our actual portfolio R&D purposes of slightly above 300 materials (those with IL-XXXX-descriptor), but what about those materials, which are not described in publications, having a potential in some application or closing a logical scientific gap? If there are no legal restrictions, our intention is to offer our customers those materials at reasonable conditions as *custom development, custom synthesis, and, on demand, also as exclusive custom synthesis*.

4.2 Custom Development: Tailoring properties by molecular design

The fundamental bases of IL-related materials are typically their often unique profiles of physical and chemical data. But what happens, if the data are not bad (ionic liquids will surely never have conductivity such as silver combined with a viscosity similar to water, but never say never!), but still do not match to a specific application? The answer can be: Tailored or designed ionic liquids!

In this case we can offer you:

a) Based on our experience we can give you a realistic estimation if your technical target (e.g. a target set of specifications & physical data) can be achieved by design or not.
b) If it can be achieved to our best knowledge, we can prepare a quotation for the development of such a tailor-made material. If the material is not described in literature so far, our philosophy concerning the intellectual property rights is quite simple: If you pay us, it's yours!

It is quite convenient that your ideas are your property and are handled as confidential.

4.3 Custom Synthesis: Ionic Liquids known from scientific publications

Another example of our daily work is the following: A customer wants to work an IL, which he has identified in the scientific literature. After he took a close look over our standard portfolio, he recognized that this specific IL is not listed within. So the question is: **Are we allowed to make it, can we make it, and what about the costs?** At this point a lot of work for our team begins, before we are in the position to offer you a quote.

The first and most important thing is to check the IP-situation. If this material falls under someone's intellectual property rights, we do not offer any quotation. If the material is instead not protected, we have the "freedom-to-operate". The next step is to check if the chosen approach to synthesize such a material is also feasible from our point of view and if the starting materials are available at reasonable prices.

Finally, we have to predict the necessary time for synthesis and analysis, ending up in an offer you couldn't refuse!

4.4 Exclusive Custom Synthesis

Finally, we offer also so called "exclusive synthesis" to our customers: If you have ideas about structures of novel materials, which shall be protected by intellectual property rights *e.g.* in combination with an application in the future or are already filed, or shall be handled as a trade secret, we offer to synthesize this material exclusively for you. This means for an agreed period of time, we do not offer the same material to any other customer, of course also even not on request. This gives our customers the necessary time to organize and process the necessary R&D and to file in case of success a patent application together with a reliable business partner. As for the custom development of a material, a non-disclosure agreement (NDA) is of course a necessary requirement.

Another important point is, if we see a risk that a target structure might not be synthesized with justifiable efforts. In this case we have the option to offer a feasibility study for a fixed price or on an hourly basis. It includes typically the development of a synthesis strategy and, in case of success, the delivery of the material. If there's no successful approach, we charge you either a fixed price (or working hours), plus material expenses. A further option is that you own also the developed synthesis route for the material afterwards.

4.5 Prices

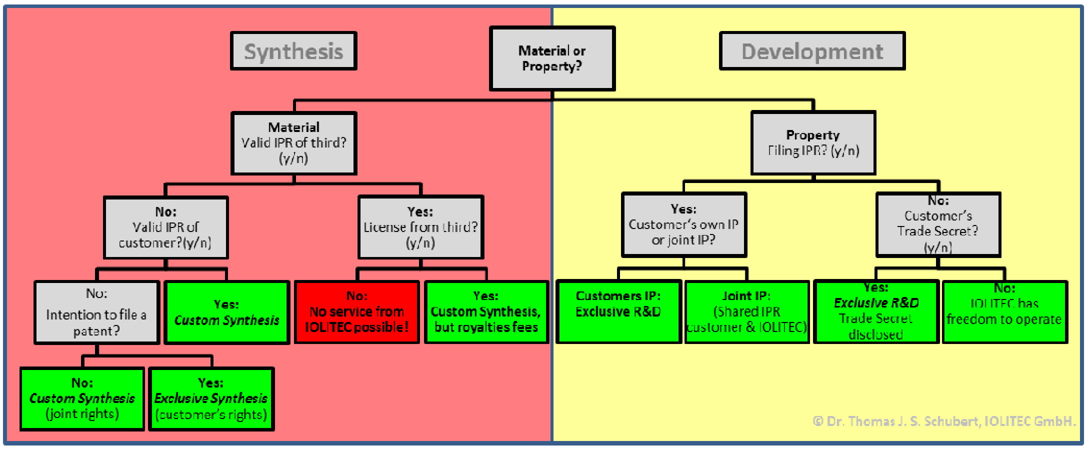
At this point, we would like to say a few words about the usually higher prices for custom synthesized ionic liquids: Our more than 300 ILs from the catalogue are produced via standard operating procedures ("SOPs"). These materials are synthesized typically at least in kg-batch-sizes or via continuous-flow technologies. As a consequence, it's quite obvious that we are in the position to offer those materials at a better price, if compared to a custom synthesized product, since we have to develop or at least to conduct a literature search for known synthesis and analysis procedures.

IOLITEC is a company, which always was, is, and will be led by its customers: Thus, numerous compounds being once synthesized after identified from one of our customers became later on part of our standard portfolio.

4.5 Summary

As part of our general services IOLITEC offers custom synthesis and exclusive synthesis. All these operations are our daily work and were already processed a couple of hundreds time before. In this context, we take care about the ideas and the knowledge of our customers and keep it confidential.

In the meantime we have synthesized and designed and characterized more than 1'000 different ionic liquids. We like to share our cumulated knowledge about ionic liquids, nanomaterials, and derived products with our customers.



Scheme 1. IPR Synthesis and Development Services.

5 Science & Applications

By Boyan Iliev (BI), Maria Ahrens (MT), Sven Sauer (SS), Frank Stiemke (FS), Jan Wimberg (JW), Jessica Klöckner (JK), and Thomas J. S. Schubert (TS).

Protic ionic liquids: Fuel cell applications (SS)

T. Yasuda, M. Watanabe, *MRS Bulletin* **2013**, *38*, 560.

Worldwide there are increased efforts to develop technologies for generating and storing renewable energies. Over the past years the major focus in energy science is the invention of novel types and principles of batteries (Li-Ion, Mg-Air and other batteries), whereas alternative technologies for energy conversion and storage are of lesser interest. One of those more or less neglected technologies is fuel cells and their applications. In contrast to batteries they offer the important advantage that renewable energy could be stored *e.g.* as Hydrogen, which may be converted directly into electricity with an efficiency not achievable by any battery today. In addition, fuel cells have a higher coefficient of performance (COP) regarding energy conversion compared to batteries. But there are also a lot of drawbacks regarding their usage: Still the infrastructure for hydrogen handling and storage is not set up in a sufficient way. Also the durability of the fuel cell needs to be improved, which is mainly limited due to destruction of the membrane separating the electrodes. Furthermore, most of the common fuel cells are limited to run at 80°C with lower efficiency since the presence of liquid water in the membrane is necessary to provide proton conductivity. The free flowing water in the membrane also causes leakage problems within the cell. In order to develop "water-free" intermediate-temperature fuel cells, new anhydrous proton conductors must be investigated as alternatives to aqueous systems. This is the point where ionic liquids may help to solve this problem.

Most of the well-known ionic liquids are designed to be aprotic with no exchangeable protons in their chemical structure based on imidazolium or pyrrolidinium cations. But they could also be designed to be protic, making them proton conductive and suitable for fuel cells. The preparation of those ionic liquids is comparable simple by neutralization reaction between a Brønsted acid and a Brønsted base, for instance the reaction between ethylamine and nitric acid leading to ethylammonium nitrate

(EAN) a protic IL (PIL). With the flexible proton they are able to develop hydrogen bonding resulting in proton conductivity similar to those of water.

Recently T. Yasuda and M. Watanabe described usage of protic ionic liquids for polymer electrolyte fuel cells (PEFC's). This type of fuel cell has the advantage of a high power density, a low operation temperature, a short startup time, a small size, and a light weight with the drawback of the high production cost. To reduce the overall costs of the fuel cell it is important to improve the efficiency of the system. One approach would be to increase the operating temperature above 100°C without humidification. In this case no water management system would be needed and a high utilization of waste heat, a thermal control by a radiator and improvement of catalyst activity could be realized.

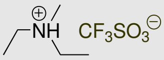
To substitute the water and increase the operating temperature of the fuel cell, they tested over 100 different protic ionic liquids and found that **diethylmethyl-ammonium trifluoromethanesulfonate (DEMA OTf, our IL-0326-HP)** is a good choice for this application due to the thermal stability and a low overpotential in fuel cell reactions. The thermal stability of PILs is highly affected by the ΔpK_a of the used acid/base combination. A minimum ΔpK_a of at least 15 is needed to provide a good thermal stability with an optimum for intermediate-temperature fuel cell applications between ΔpK_a = 16-18.

They concluded that a membrane of sulfonated polyimide in ammonium form exhibited good compatibility with the PIL and gave a flexible and mechanically strong composite membrane. This setup was successfully used in non-humidifying fuel cell operation at 120°C with a maximum current density of 400 mA/cm^2 and a maximum power density of 100 mW/cm^2. Also a hydrophobic alternative PIL (ethylmethyl-propylammonium nonafluorobutanesulfonate, our CS-0995) showed good thermal stability and high ionic conductivity but a lower electrochemical activity.

In summary, protic ionic liquids are suitable candidates to give new impulses for improvements in fuel cell research.

Diethylmethylammonium trifluoromethanesulfonate, 98% **NEW**

IL-0326-HP [--] $C_6H_{14}F_3NO_3S$ MW 237.24



25 g	56.00 €
50 g	74.00 €
100 g	123.00 €
250 g	255.00 €
500 g	417.00 €
1 kg	750.00 €
5 kg	3’000.00 €

A new conducting salt for high voltage propylene carbonate-based electrochemical double layer capacitors (BB)

S. Pohlmann, A. Balducci, *Electrochim. Acta* **2013**, *110*, 221.

Electrochemical double layer capacitors (EDLCs) are currently considered as one of the most promising devices for electrochemical storage due to their high power (up to 10 $kW\cdot kg^{-1}$) and high cycle life (> 500'000). Commercially available EDLCs contain either aqueous or organic electrolytes. As organic electrolytes typically quaternary ammonium salts in propylene carbonate (PC) or acetonitrile (ACN) are used. EDLCs containing organic electrolytes display operative voltages of about 2.7 – 2.8 V and energy of 5 $Wh\cdot kg^{-1}$. To broaden the field of applications of EDLCs higher energy is needed. Therefore extensive research has been done in the last years.

Recently *Balducci et al.* reported about the use of **1-butyl-1-methyl-pyrrolidinium tetrafluoroborate (BMPyrr BF_4, IL-0077-HP)** in combination with propylene carbonate as novel electrolyte in electrochemical double layer capacitors. The 2.3 M mixture of BMPyrr BF_4 in PC showed comparable values of conductivity and viscosity to the conventional PC-based electrolyte tetraethylammonium tetrafluoroborate (1 M Et_4N BF_4 in PC). Using this novel conducting salt in PC enables the realization of EDLCs with an operative voltage of 3.2 V. At this voltage these EDLCs displayed a high cycling stability, which was confirmed by charge-discharge experiments and float voltage tests. Changing the conductive salt is an attractive strategy to realize high voltage and high performance EDLCs.

High efficiency $CH_3NH_3PbI_{(3-x)}Cl_x$ perovskite solar cells with poly(3-hexylthiophene) hole transport layer (BI)

F.Di Giacomo, S. Razza, F. Matteocci, A. D'Epifanio, S. Licoccia, T. M. Brown, A. Di Carlo, *Journal of Power Sources* **2014**, ***251***, 152.

Pervoskite solar cells emerge almost 15 years ago, and although they have had at least 10 years less to mature than "normal" liquid electrolyte dye-sensitized solar cells (DSSC) they have managed recently to better them in performance. According to the authors, the best DSSC cell shows performance of 12.3%, which is comparable to the best pervoskite cells, which show 10.3% in the standard configuration (Figure 1). If the TiO_2 is replaced by Al_2O_3 performance can increase to over 12%.

Although the term pervoskite generally refers to calcium titanium oxide mineral species, it is used also for other compounds with the same crystal structure, namely ABX_3. In the content of DSSC it usually means organometal halides such as e.g. CH_3NH_3 PbX_3, where X is a halide, or a mixture of halides. The general structure of such a cell is given in Figure 1.

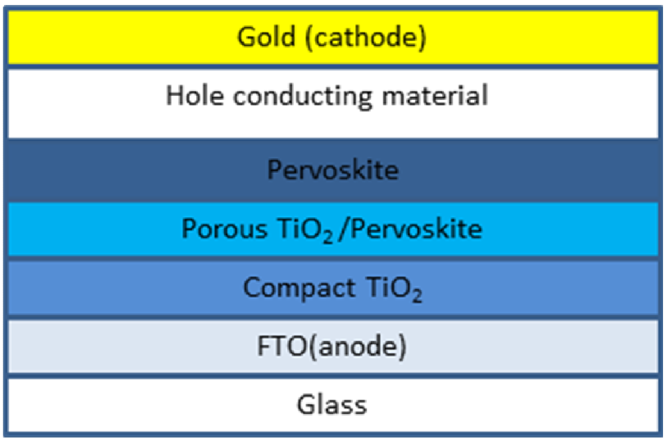


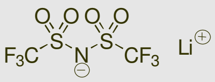
Figure 1. The general schematic structure of a pervoskite solar cell

The main difference to classic DSSCs is the lack of a liquid iodine electrolyte, and the presence of a hole conducting material. As such come to use conjugated materials like 2,20,7,70-tetrakis-(N,N-dip-methoxyphenylamine)9,90-spirobi fluorene (Spiro-OMeTAD), poly(3-hexylthiophene-2,5-diyl), which is cheaper and has almost the same efficiency or even inorganic salts such as CuI[1]. Of course, as it is common in life, you have to pay the price for a good performance. The cheap version with the CuI has "only" about 8% efficiency, which is still quite amazing, having in mind the higher stability of the inorganic salt and its much lower price, compared to the complex organic molecule.

As additives for optimizing the cell performance the authors use two compounds only too well known to our company: One of them is lithium bis(trifluromethyl-sulfonyl)imide and the other one is a common "normal" DSSC additive *tert*-Butylpyridine. From our own experience in the field of DSSC additives we can only suggest to use *N*-Octylbenzimidazole instead, as it has proven more effective in iodide based electrolytes.

Lithium bis(trifluoromethylsulfonyl)imide, 99%

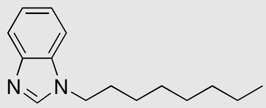
KI-0001-HP [90076-65-6] $C_2F_6LiNO_4S_2$ MW 287.19



100 g	140.00 €
250 g	250.00 €
500 g	300.00 €
1 kg	375.00 €
5 kg	1500.00 €
10 kg	2700.00 €

1-Octylbenzimidazole, >98%

KI-0045-HP [42032-46-2] $C_{15}H_{22}N_2$ MW 230.35



25 g	113.00 €
50 g	201.00 €
100 g	322.00 €
250 g	645.00 €
500 g	1'031.00 €
1 kg	1'650.00 €

Recommended further reading:

J. Burschka, N. Pellet, S. Moon, R. Humphry-Baker, P. Gao, M. Nazeeruddin, M. Grätzel, *Nature,* **499**, 316–319.

M. Loi , J. Hummelen, *Nature Materials*, **12**, 1087–1089

M. He, D. Zheng, M. Wang, C. Linb, Z.Lin, *J. Mater. Chem. A*, **2014**, Advance Article, DOI: 10.1039/C3TA14160H.

[1] *J. Am. Chem. Soc.*, Article ASAP **DOI:** 10.1021/ja411014k

Electrospinning of chitin nanofibers directly from an ionic liquid extract of shrimp shells (BI)

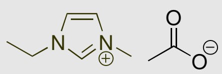
P. S. Barber, C. S. Griggs, J. R. Bonner, R. D. Rogers, *Green Chem.* **2013**, *15*, 601.

Due to their high molecular weights and other features like biodegradability and the recovery from renewable resources, nanofibers prepared from biopolymers are gaining more and more interest. These biopolymers include cellulose, chitosan and chitin, whereas the latter is applicable for biosensing and –catalysis, filtration, wound care and energy storage. Because chitin is extracted from crustacean shells an additional benefit lies in the recycling of bio-waste of the shellfish industry. However, chitin is barely soluble in most solvents due to inter- and intramolecular hydrogen bonding. Therefore, strong acids and basic systems need to be applied for demineralisation and deprotonation, which in turns leads to degradation of the biopolymer.

The use of imidazolium-based ionic liquids for the dissolution of cellulose is well described. For chitin more basic anions - such as acetate - are necessary due to the large number of hydrogen bond donors and acceptors. In order to achieve the maximum benefit of chitin, an easy way is desired to produce the nanofibers from the crustacean extract with the aid of the electrospinning-technique, in which an electric field is used to pull nano-sized fibers from a polymer solution. It turned out that these chitin nano-sized fibers can be produced directly from a shrimp shell extract (2.0 wt%) using the ionic liquid 1-ethyl-3-methylimidazolium acetate (EMIMOAc, our IL-0189) in a one pot system *via* electrospinning. This extract composition ensures the ideal concentration as well as optimal viscosity and entanglement density. The further application of ionic liquids for the extraction and production of biopolymer-based fibers is very promising.

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

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



25 g	60.00 €
50 g	75.00 €
100 g	115.00 €
250 g	175.00 €
500 g	265.00 €
1 kg	395.00 €
5 kg	1’580.00 €

Ionic liquids as ingredients in topical drug delivery systems (JK)

D. Bobler, T. Schmidt, I. Klingenhöfer, F. Runkel, *Int. J. Pharm.* **2013**, *441*, 620.

In some applications topical medication offers great opportunities like prolonged therapeutic action, improved patient adherence and avoidance of first-pass metabolism. Nevertheless an active drug needs to cross the stratum corneum barrier. For this many attempts have been made to increase the transdermal delivery systems by means of microneedles, ultrasound, vehicles and many more. Although some improvements were achieved these methods, especially the physical enhancements, are not convenient for daily utilization.

Since ionic liquids turned out to be a useful tool for dissolution of barely soluble drugs and for antimicrobials they are gaining interest in the research of formulations for topical drug delivery. For this purpose water/oil emulsions were prepared and the ionic liquid was integrated in the water or the oil phase, respectively, depending on the solubility of the IL, i.e. (HMIM Cl), our IL-0054-HP in the water phase and (BMIM PF_6 our IL-0011-HP) in the oil phase. It could be demonstrated that by using formulations containing ILs the penetration into the skin layers could be enhanced and for penetration into even deeper skin layers a combination of lipophilic active ingredients with hydrophobic BMIM PF_6 should be more efficient. The improvement of the penetration by using ionic liquids could be verified by application of a fluorescent dye that serves as a model drug. Furthermore, the successfully incorporated in the formulations, the ionic liquid showed antimicrobial activity in concentrations above 5 %, so they might be useful for preservation as well. In spite of the antimicrobial activity evaluations of the cytotoxicity demonstrated a low *in vitro* cytotoxicity of the carriers.

Microfluidic tactile sensors for three-dimensional contact force measurements (FS)

B. Nie, R. Li, J.D. Brandt, T. Pan *Lab Chip*. **2014**, *22*, 4344.

In our today's world sensors are almost needed everywhere: from analytical to medical devices. In particular for medical monitoring, robotic surgery or prosthetic applications there is a need for force sensing devices, which are accurate, flexible and not expensive. The authors report about the probably first microfluidic tactile sensing device, which can measure three-dimensional contact forces using the microfluidic interfacial capacitive sensing principle.

Therefore, a microfluidic sensing fluid is needed which exhibits high conductivity, low viscosity and is stable under the operation conditions without changes in physical properties. All these requirements found the authors fulfilled in the ionic liquid 1-ethyl-3-methylimidazolium tricyanomethanide (EMIM TCM, IL-0316-HP), with conductivity at 18 mS cm−1, viscosity at 18 Pas, Elektrochemical stability (ECW) of 2.9 V and negligible vapor pressure. This ionic liquid enabled them to manufacture a polymer-liquid-based flexible and highly sensitive device with fast mechanical responses times. They demonstrated the potential of this device as a fingertip-mounted sensor to continuously track finger movements.

6 Community

IOLITEC@ Social Media

Please follow IOLITEC at Facebook or connect yourself with IOLITEC's team at LinkedIn!

Interesting Videos:

YouTube:

http://www.youtube.com/watch?v=eB2EN8PPgDE&list=PL024647A48C5E7E9A

If you follow this link, you'll see the interesting properties of 3M^{TM} inert fluids of the NOVEC^{TM}-family.

Interesting Links:

https://www.ppm.uni-freiburg.de/

Ingo Krossing's idea of creating an absolute scale for the pH-value, which is independent from the chosen solvent, led to the concept of the "protoelectric potential map" (PPM). Please take a careful look at this, think, and maybe you come to the conclusion that this is an excellent, but also missing piece in the big puzzle of chemistry! (TS)

Upcoming conferences:

Achema 2015 Congress, Frankfurt, Germany, June 15th – 19th, 2015.

Parallel to the leading exhibition for the process industry the Achema congress takes place in 2015. Dr. Boyan Iliev will give the following presentations during the course of the congress: "*Ionic liquids for biomass dissolution*" and "*Ionic liquids as effective dispersants for easy- and safe-to-handle nanodispersions*". Please visit our website for the latest updates closer to the event.

COIL-6, South Korea, June 16th – June 20th, 2015.

The world's most important conference about ionic liquids will be held in Jeju, South Korea. After 2007 in Yokohama it is the second time that this conference is in Asia.

The submission of abstracts is already open and will end on February 6th, 2014.

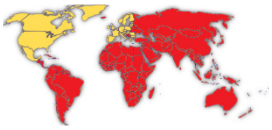
IOLITEC's CEO, Dr. Thomas J. S. Schubert, is again member of the international advisory board and will be present at the complete conference.

Further information is available at:

http://www.coil-6.org/

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

Contact and Order Information:



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