Basionics
Ionic Liquids - solutions for your success
BASF
The Chemical Company

BASF is the world’s leading chemical company: The Chemical Company. Its portfolio ranges from chemicals, plastics, performance products and agricultural products to oil and gas. As a reliable partner BASF creates chemistry to help its customers in virtually all industries to be more successful. With its high-value products and intelligent solutions, BASF plays an important role in finding answers to global challenges such as climate protection, energy efficiency, nutrition and mobility.

Top intermediates supplier
The operating division Intermediates of the BASF Group develops, produces and markets the world’s largest range of intermediates. The most important of the division’s more than 600 products include amines, diols, polyalcohols, acids and specialties. Among other applications, intermediates are used as starting materials for coatings, plastics, pharmaceuticals, textile fibers, detergents and crop protectants. Innovative BASF intermediates help to improve the properties of the final product and the efficiency of production processes. The ISO 9001:2000-certified operating division Intermediates operates plants in Europe, Asia and the Americas.
Ionic Liquids - high-potential solutions

Ionic Liquids have gained overwhelming interest over the past years, because they offer unique sets of properties not achievable with any other material. This opens up opportunities in many different applications. They might be just a replacement for the material currently used – as for example reaction media in chemical processes. Or they are an “enabling technology” that allows totally new solutions – as for example in manufacturing cellulose derivatives. They are being considered as high-potential solutions in a broad range of application segments: in chemical reactions and separation processes, in processing metals and polymers, especially biopolymers like cellulose, as electrolytes in electronic devices and, last but not least, as functional or engineering fluids in many different applications.

BASF offers easy access to a wide range of products (Basionics™) with a broad variety of properties. We will obviously help you to implement ionic liquid technologies to your processes and products with any support you need. This also includes licensing of BASF technologies utilizing Ionic Liquids (Basil™) as well as joint developments leading exactly to the products or processes that meet your requirements.

 Ionic Liquids and eco-efficiency

Besides their technical and economic advantages, Ionic Liquids are often claimed to be “green” chemicals, mainly by reference to the fact that they show no vapor pressure. However, it might be misleading to assume that non-volatility alone makes a material “green.” A more precise approach needs to evaluate the whole process from “cradle to grave” – including a toxicological assessment of the Ionic Liquid involved. This has been done, for example, for BASF’s BASIL process in the synthesis of phosphorous compounds – and resulted in the “Eco-efficiency Analysis Label” in 2005. BASF is prepared to investigate ionic liquid products and processes together with customers by means of an eco-efficiency analysis.
Ionic Liquids from BASF

Basionics:
Broad portfolio - meeting your requirements

BASF has developed the Basionics portfolio of Ionic Liquids offering a broad variety of properties. The focus in this product line is on imidazolium salts. All products are available from lab to industrial scale (for a detailed list see pages 6 and 7 in this brochure). Our existing production capacities ensure flexibility, reliable supply and global availability. On your request we are also pleased to check our capabilities for those products not included in our portfolio so far, as well as special requirements on specifications.

Small quantities of our Basionics for testing and screening are provided by our partner Sigma-Aldrich (please refer to www.sigmaaldrich.com).

Basil:
BASF’s ionic-liquid-based processes

We invite you to benefit from our pioneering work utilizing Ionic Liquids in chemical processing. Several processes applying Ionic Liquids in synthesis and separation steps have been elaborated within BASF, and we are pleased to license them to you (Basil processes). However, if you need a very specific solution, why not enter into an exclusive cooperation agreement with us, and we will jointly develop new processes that exactly meet your needs. With our expertise in using Ionic Liquids, we will help you to harness your potential and raise yields, improve efficiency and simplify processes.
The mechanical properties of components made of glass fiber-reinforced epoxy resins are determined by means of state-of-the-art testing equipment.

Ionic Liquids - fascinating new materials with unique sets of properties

- liquid at <100°C, often liquid at room temperature
- broad liquid range
- virtually no vapor pressure
- non-flammable
- excellent thermal, mechanical and electrochemical stability
- electrical conductivity
- exceptional dissolution properties
## Product list Ionic Liquids

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Ionic Liquids - offering outstanding advantages

Chemical processing and fine chemicals
- reaction media, for example in catalytic processes
- reaction media, for example in nucleophilic substitutions
- auxiliary for acid scavenging (BASIL)

Metal processing
- electroplating of aluminum onto steel
- electroplating of chromium
- electropolishing of steel and other metal surfaces

Polymer and biopolymer processing
- solvent for regenerating cellulose (e.g. fibers and films)
- enabling technology for manufacturing cellulose derivatives
- dissolution and separation of lignocellulosic biomass

“Ionic Liquids are a class of fascinating, new liquid materials with unique combinations of properties. The performance of an Ionic Liquid in a given application is a strong function of the ions forming the liquid. Several systematic approaches are available towards improving the performance by structural design.”

Prof. Peter Wasserscheid, University of Erlangen, Germany
Electrochemistry and electrolytes
- high-performance electrolyte in lithium ion batteries
- and supercapacitors
- solvent and electrolyte in dye-sensitized solar cells

Separation processes
- entrainer in extractive distillations, e.g. ethanol/water
- extraction processes (e.g. aromatics from aliphatics)
- purification of gases

Engineering fluids
- non-flammable hydraulic liquids
- high-performing lubricants
- liquid piston and gas compression

Functional fluids
- antistatic additives
- catalysts (e.g. polyurethanes)
- reactive building blocks
- other polymer additives
Chemical processing and fine chemicals

Ionic Liquids - a new and valuable tool in the chemist’s toolbox

As reaction media in chemical processes Ionic Liquids can be valuable tools to achieve higher yields and/or lower manufacturing costs, for example in

- catalytic reactions like hydroformylation, hydrosilylation or FRIEDEL-CRAFTS as well as biocatalytic and enzymatic reactions,
- nucleophilic substitution reactions,
- acid scavenging with BASF’s BASIL process.

“There’s no reason why someone should use Ionic Liquids if he is happy with what he is already doing. But if he has problems, Ionic Liquids are valid possible alternatives to try - and there is a great chance that they may work.”

Prof. Ken Seddon, University of Belfast, Northern Ireland, UK
Electrochemical applications

Ionic Liquids - new prospects for more sustainable energy technologies

Electrochemical devices are getting more and more attractive with the increasing interest in generating electricity from renewable resources. Ionic Liquids can offer valuable contributions:

- customized products for electrolytes in lithium ion batteries
- electrolytes allowing higher power densities in super capacitors
- solvent free electrolyte for dye sensitized solar cells

Light

- Transparent conductor (anode)
- Nano porous TiO₂ layer
- Photosensitive dye
- Ionic Liquid Formulation (incl. I₂/I₃⁻)
- Conducting substrate (cathode)

Ionic Liquids in dye sensitized solar sells (“Graetzel-Cells”)

“Low viscous, non volatile liquids showing electric conductivity - this is not achievable with any other material than Ionic Liquids, qualifying them as new materials for electrolytes.”

Heiko Kupfer, BASF SE
Polymer and biopolymer processing

Ionic Liquids - enabling technology to utilize cellulose

The exceptional dissolution properties of Ionic Liquids for polymers and especially biopolymers such as cellulose open up totally new opportunities for new products as well as processes, for example:

- inert solvent for cellulose – allowing any kind of derivatization,
- higher utilization of the most abundant raw material source: cellulose,
- a broad range of opportunities in processing polymers and biopolymers.

Regenerated cellulose (e.g. “Viscose Fibres”)

“I believe that the ability of certain Ionic Liquids to directly dissolve and efficiently separate the key biomass components, cellulose, hemicelluloses, and lignin, could be the technological key to enabling a sustainable hydrocarbon economy!”

Prof. Robin Rogers, University of Alabama, Tuscaloosa, USA
Metal processing

Ionic Liquids - unprecedented prospects for metal deposition

The high electrochemical stability of Ionic Liquids allows electrochemical deposition of less noble metals like aluminum or titanium, which is not possible with conventional aqueous electrolytes. Examples:

- electroplating of aluminum onto steel
- electroplating of chromium
- electropolishing of steel and other metal surfaces

“Ionic Liquids can be specifically modified by additives to high performing electrolytes in electroplating processes for the galvano industry.”

Dr. Jochen Mezger, BASF SE
“One of the largest resources of energy is simply to save energy. And it is exactly here where Ionic Liquids can make their contributions.”

Dr. Klemens Massonne, BASF SE
Separation processes

Ionic Liquids - with new opportunities to higher profitability

The unique dissolving and miscibility properties of Ionic Liquids offer great potential in a broad range of separation processes, for example:

- as an entrainer in extractive distillations, e.g. ethanol/water,
- in extraction processes (e.g. aromatics from aliphatics),
- purification of gases.

“Ionic Liquids are characterized by exceptional dissolution properties. This opens up opportunities in utilizing them as auxiliaries in e.g. extractive distillations - leading to processes with higher profitability.”

Dr. Uwe Vagt, BASF SE
Basionics are used as high performance antistatic additives in different polymer applications.

**Basionics - new prospects for polymer chemists**

The specific interaction of Basionics with different kinds of polymers makes them attractive materials as high performance polymer additives, esp. as these interactions are easily tunable by the design of the Ionic Liquids

- antistatic additive (e.g. thermoset, engineering plastics, coatings)
- functionalised building blocks for resins manufacture
- latent hardeners (e.g. polyurethane, epoxy)
- other polymers additives

“To optimize the properties and the processibility of polymers becomes more and more important with increasing customer requirements for high performing polymers.”

Dr. Laszlo Szarvas, BASF SE
BASF’s Ionic Liquids - customized solutions for you

Close cooperation - our business models

We are your full-service partner when you are evaluating your possibilities to use Ionic Liquids. Backed by our technological expertise, we provide support for engineering processes, whether they are close to implementation or just developed on a laboratory scale, or we investigate together with you whether your ideas can be realized. Naturally, we supply you with one of our Basionics products or customized Ionic Liquids designed to fit your needs. We offer licenses for our intellectual property covering Ionic Liquids and especially for our Basil processes, and we actively encourage and support joint research agreements, which have previously proven to be highly beneficial for the parties involved.

How to get exactly the Ionic Liquid you need?

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*in co-operation with Sigma-Aldrich

- Basionics or customized Ionic Liquids ➡️ Supply contract
- Licenses for our IP and know-how ➡️ Licensing agreement
- Cooperation projects ➡️ Joint development agreement
Worldwide support

We offer you a full range of services around the globe:

- Our team of experts and consultants will advise you throughout the implementation.

- Starting from first lab trials we support you on your way to realizing new processes and products on a commercial scale.

- On request, we will design the recycling of Ionic Liquids after use and will assist you in all aspects of chemical legislation (e.g. REACH), backed by our internationally renowned expertise in toxicology and ecotoxicology.
Contact us

Europe
Dr. Uwe Vagt
Phone: +49 621 60 - 48616
uwe.vagt@basf.com

NAFTA
Dr. Megan O’Meara
Phone: +1 973 245 - 6541
megan.omeara@basf.com

Asia
Koichiro Aoyagi
Phone: +81 3 3796 - 4945
koichiro.aoyagi@basf.com

For the supply of BASIONICS ionic liquids in small quantities please contact:

SIGMA-ALDRICH

www.sigmaaldrich.com