# Application Sheet

io·li·tec
Ionic Liquids Technologies

## Electrolytes for Lithium Ion Batteries

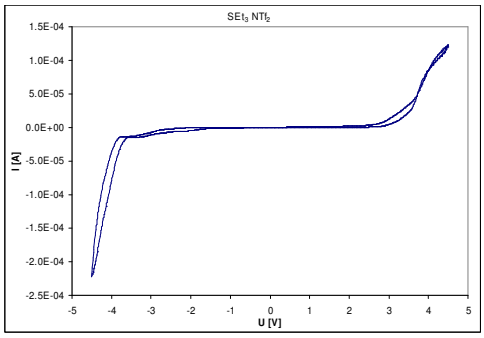
The search for power sources for mobile technology is one of the interesting and most important fields of modern research. Because of its economical relevance, large R&D spendings will be made over the next years.

The need for high voltage, high capacity, long-life lithium secondary batteries as large-scale energy storage devices has become even more important with the rise of hybrid technology in cars or with the success of iPods and related consumer products.

Conventional lithium ion secondary batteries contain a non aqueous organic solvent (e.g. ethylene or propylene carbonate) as an electrolyte together with a separator and a lithium salt. The volatility and inflammability of these organic solvents can cause trouble, as some recent press releases let suggest.

In this context, ionic liquids have attracted much attention because of their unique mix of properties, like

- **non flammability**
- **non volatility**
- **thermal stability**
- **large electrochemical windows**
- **high ionic conductivities**




Cyclovoltammogram of $SEt_3$ $NTf_2$.

### Selected Examples:

***Sakaebe*** **and** ***Matsumoto*** have reported a battery consisting of ***N*****-methyl-*****N*****-propyl-piperidinium bis(trifluoromethylsulfonyl)imide** together with a lithium salt,[1] while ***Howlett et al.*** used ***N*****-methyl-*****N*****-butyl-pyrrolidinium bis(trifluoromethylsulfonyl)imide** in a similar approach.[2]

***Seki et al.*** demonstrated that a lithium ion battery using ***N,N*****-diethyl-*****N*****-methyl-*****N*****-(2-methoxyethyl)-ammonium bis(trifluoromethylsulfonyl)imide** as the electrolyte can be charged and discharged for more than 100 cycles, if the $LiCoO_2$ is coated with $ZrO_2$.[3]

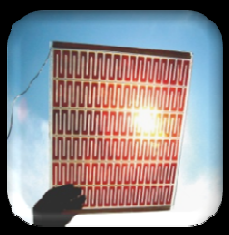
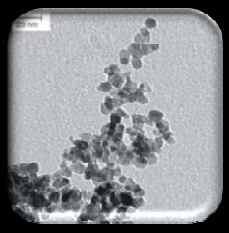
At our own laboratories we have developed procedures for the synthesis of **triethyl-sulfonium bis(trilfuoromethylsulfonyl)imide** and ***N*****-butyl-*****N*****-trimethyl-ammonium bis(trifluoromethyl-sulfonyl)imide**. Furthermore, the **conception of novel, more stable weakly coordinating anions** is currently under investigation.

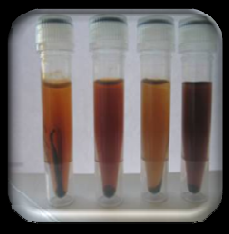
| Product Code | Compound | Quantities |
|---|---|---|
| IL-0045-HP | *N*-Methyl-*N*-propyl-piperidinium bis(trifluoromethylsulfonyl)imide, 99% | 25 g to bulk |
| IL-0035-HP | *N*-Methyl-*N*-butyl-pyrrolidinium bis(trifluoromethylsulfonyl)imide, 99% | 25 g to bulk |
| IL-0032-HP | *N*-Butyl-*N*-trimethyl-ammonium bis(trifluoromethylsulfonyl)imide, 99% | 25 g to bulk |
| IL-0030-HP | Triethylsulfonium bis(trifluoromethylsulfonyl)imide, 99% | 25 g to bulk |

### References:


[1] H. Sakaebe and H. Matsumoto, *Electrochem. Commun.* **2003**, *5*, 594.
[2] P. C. Howlett, D. R.MacFarlane and A. F.Hollenkamp, *Electrochem. Solid-State Lett.* **2004**, *7*, A97.
[3] S. Seki, Y. Kobayashi, H. Miyashiro, Y. Ohno, Y. Mita, A. Usami, N. Terada, M. Watanabe, *Electrochem. Solid-State Lett*, **2005**, *8*, A577.





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