Lithium imidazolide (LiTDI) as a challenger for $LiPF_6$ in lithium batteries

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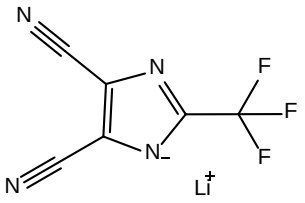
Lithium salts having an Hückel anion derived from imidazole such as lithium 4,5-dicyano-2-(trifluoromethyl) imidazolide **(LiTDI)** have been synthetized in 2008 by Leszek Niedzicki et Michel Armand and a patent has been deposited in 2009 [1,2]. Among all imidazole derived salts, LiTDI is probably the most promising and could be a challenger to $LiPF_6$ in the future. Unlike to LiPF6, this salt is not water sensitive and stable at high temperatures (200°C). As no HF is expected to be produced during battery cycling, corrosion of cathode material or metallic collector is avoided. LiTDI solutions in alkylcarbonate (AC) are able to form an adequate passivation layer on graphite and are compatible with high voltage cathodes up to 4.7V. Like $LiPF_6$, LiTDI based electrolytes are able to passivate aluminium collectors. The main drawback of LiTDI is the lower conductivity (6.8 $mS.cm^{-1}$ à 1 $mol.L^{-1}$ in EC/DMC à 25°C, Niedzicki et al.) as compared to $LiPF_6$ in the same AC solvent mixtures.



Structure of the TDI Hückel anion

In this work LiTDI is compared to competing salts like LiTFSI, LiFAP and $LiPF_6$ in a EC/DMC (50/50 wt%) mixture. Transport properties such as viscosity, Li+ and anion diffusivity and lithium transference number, were investigated and show the inadequacy of the EC/DMC mixture as only 36 % of the ion-pairs are dissociated.

Taking into account these results, a new solvent mixture (quoted as NSM in the following) has been designed. The LiTDI/NSM electrolyte has been tested and compared to the LiPF6/AC electrolyte in graphite (GR) and NMC half cells at different rates of discharge.

All results confirm that LiTDI/NSM could replace $LiPF_6$ as an electrolyte in many Li-ion batteries.

1. *Niedzicki, L., et al., New type of imidazole based salts designed specifically for lithium ion batteries. Electrochimica Acta, 2010. 55(4): p. 1450-1454.*
2. *Bukowska, M., et al., Pentacyclic anion salt and use thereof as an electrolyte, WO 2010023413 A1, PCT/FR2009/051642, 4 mars 2010.*