

Nanostructured electrode and electrolyte materials in electrochemistry

Torresi, R. M. ^{(1)*}, Monteiro, M. J. ⁽¹⁾, Benedetti, T. M. ⁽¹⁾ and Bazito, F. F. C. ⁽²⁾

(1) Instituto de Química, Universidade de São Paulo, CP 26077, 05513-970 São Paulo, SP, Brazil

(2) Depto. de Ciências Exatas e da Terra, Univ. Federal de São Paulo, Campus Diadema, 09972-270, São Paulo, SP, Brazil.

* Corresponding author: rtorresi@iq.usp.br

Some transition-metal oxides are a promising material for cathode in rechargeable lithium-ion batteries. Nevertheless, some of these oxides, such as, manganese oxide present some problems, like capacity fading after several charge/discharge cycles and also low diffusion coefficient for lithium cation. The way to deposit the material on the substrate can avoid this problem of capacity fading; however, it is practically impossible to change the diffusion coefficient. So that, the improving of power density on lithium-ion batteries depends on the use of nanostructured materials. By using nanostructured materials of defined morphology is possible to change the diffusion length and also to increase the relative percentage of material on the surface and as a consequence of that, power density can be increased.

Also much effort were done searching for reliable power sources for electrical engines leading to synthesize new electrolytes to be used in Li-ion batteries in order to make them powerful and safe. Ionic liquids have been widely studied for this purpose. Lithium salt solutions of $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, LiTFSI, in a room-temperature ionic liquid (RTIL), 1-butyl-2,3-dimethyl-imidazolium cation, BMMI, and the $(\text{CF}_3\text{SO}_2)_2\text{N}^{1-}$, bis(trifluoromethanesulfonyl)imide anion, [BMMI][TFSI], were prepared in different concentrations. The addition of a lithium salt to this RTIL decreases the mobility of all species, especially Li^+ . Estimated conductivities (NMR-PGSE), Raman spectroscopy and Molecular Dynamics Simulation data suggest the formation of aggregates formed by [TFSI] anions around Li^+ , with [TFSI]'s oxygen atoms pointing toward Li^+ . In order to improve Li^+ diffusion, cations such as the 1,2-dimethyl-imidazolium, N-methylmorpholine and N-N-dimethylethylamine were synthesized. These RTIL's have a conductivity 40% higher than [BMMI][TFSI]. If the increase of the conductivity was only a consequence of the diminishing of the viscosity, the Walden Plot for the two RTIL's must present the same slope. In fact, the slopes are different, which suggests that the ether chain add some structural modification to the system, showing that changes in charge transport is not only a function of the fluidity.

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