Lithium NMR for Polymer Electrolyte Batteries

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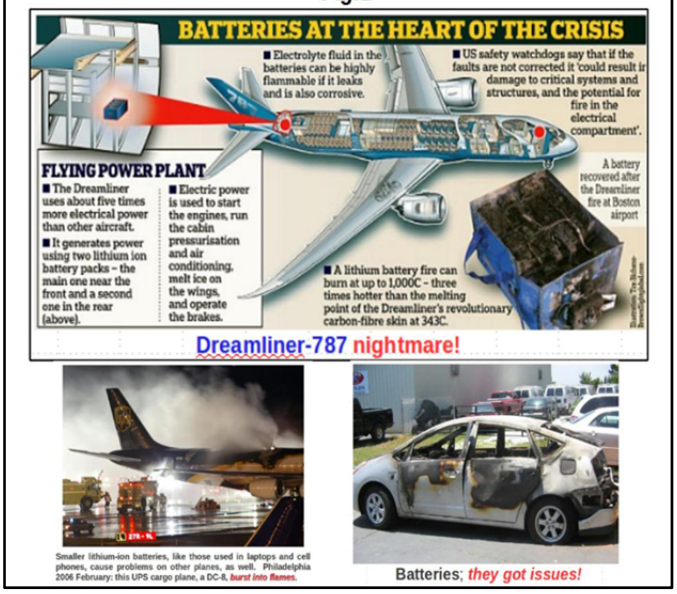
Introduction

Lithium ion batteries (LiBs) suffer from the malady that during charging and discharging needle like dendrites and other metallic microstructures(8) that in addition to degrading the battery performance, could also lead to *short circuit* and ***fire!*** Further, the liquid electrolyte (EL) in LiBs is a very combustible and aggressively reactive when exposed to air. The accidental seepage of electrolyte outside the battery casings has been implicated as the cause of ***fire*** in some highly publicized cases as shown in Fig.1 (1).

Replacing the conventional liquid electrolyte by solid (polymer) electrolyte (pEL) circumvents this problem (1-3). ***Polymer electrolytes do not leak!*** pEL's *reduce* the *fire* risk as they cut down the size of dendrites that are formed during charge/discharge cycles as described above. They also reduce the current losses due to the dendrite formation, proportionally rescuing the battery performance. Thus the pEL's promote *both* safety *and* performance.

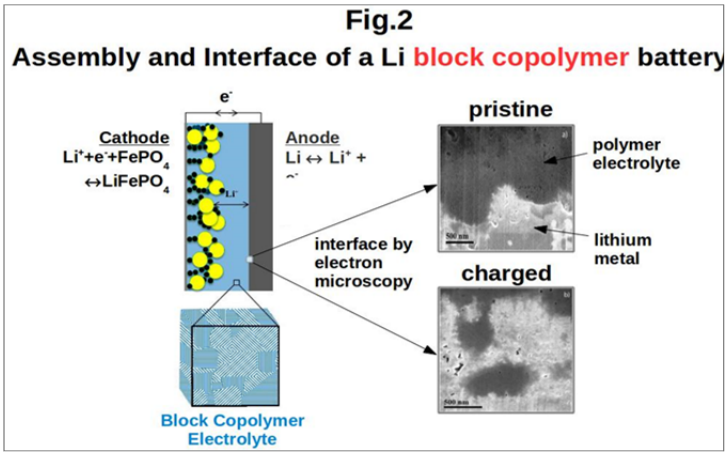
Fig.1



Experimental

We are currently implementing in-situ NMR studies on pEL LiB's to monitor non-invasively the transport characteristics and dendrite formation on 21T magnet system at NHMFL.

Fig.2



Results and Discussion

We have undertaken synthesis of polymer electrolyte and have obtained consistently good quality products. We have obtained preliminary magnetic resonance data on test batteries using a prototype lithium resonator. A lithium resonator is currently under construction for the 21T magnet system by the RF lab. The availability of this resonator in the near future will provide a much needed boost to this project, as well as the preliminary magnetic resonance data.

References

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[3] Hallinan, D.T., *et al.*, J of Electrochemical Society, **160**, A464-A470 (2013).