

## Supporting Information

### Development of Novel Lithium Borate Additives for Designed Surface Modification of High Voltage $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$ Cathodes

Mengqing Xu,<sup>a</sup> Liu Zhou,<sup>a</sup> Yingnan Dong,<sup>a</sup> Yanjing Chen,<sup>a</sup> Julien Demeaux,<sup>a</sup> Alex D. Mac Intosh,<sup>a</sup> Stefano Meini,<sup>b</sup> Arnd Garsuch,<sup>b</sup> and Brett L. Lucht<sup>a,\*</sup>

- a. Department of Chemistry, University of Rhode Island, Rhode Island 02881, USA  
b. BASF SE, GCN/E, Ludwigshafen am Rhein 67056, Germany

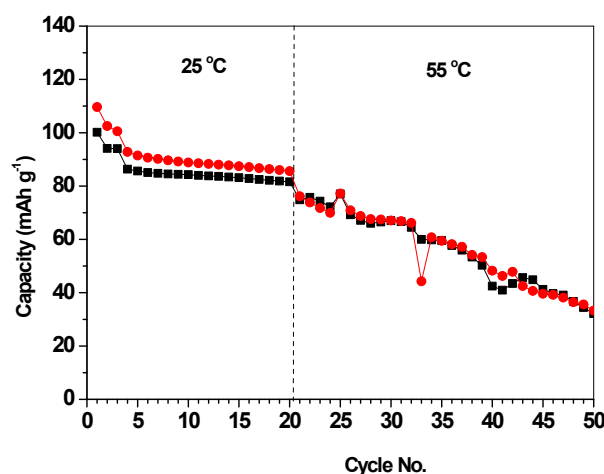


Fig. S1 Reproducible Cycling data of cells with baseline electrolyte at room temperature (25 °C) and elevated temperature (55 °C)

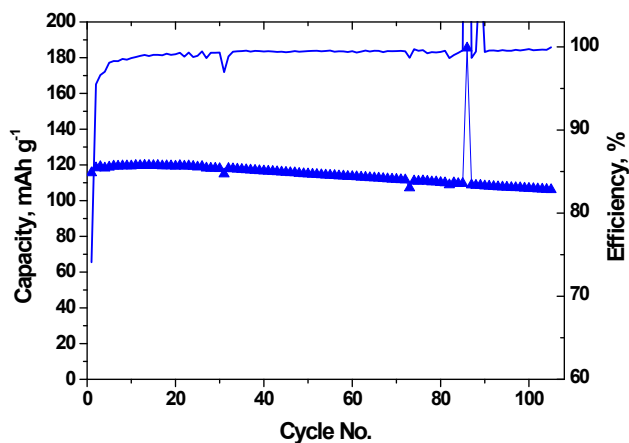


Fig. S2 Prolonged cycles of graphite /  $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$  cell with baseline electrolyte at room temperature.

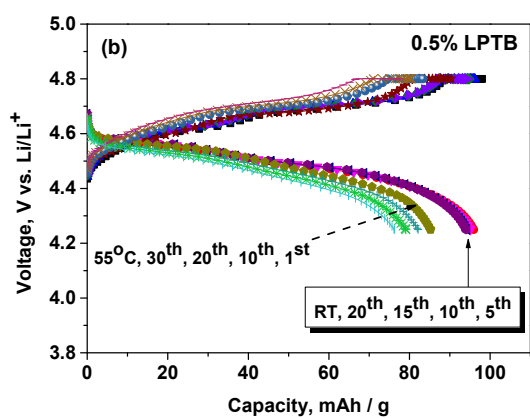
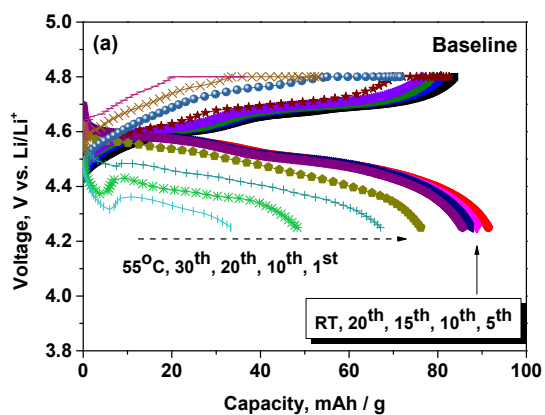


Fig. S3 Charge/ discharge profiles of the cells with and without additive for selected cycles

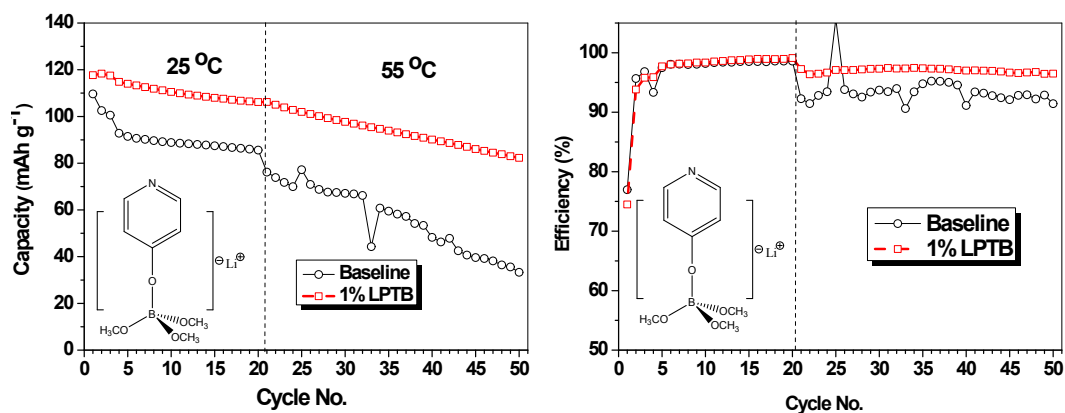
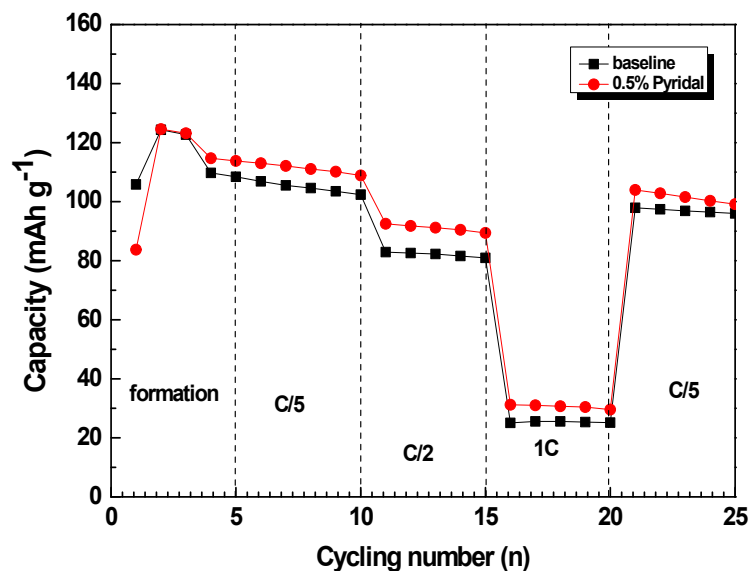
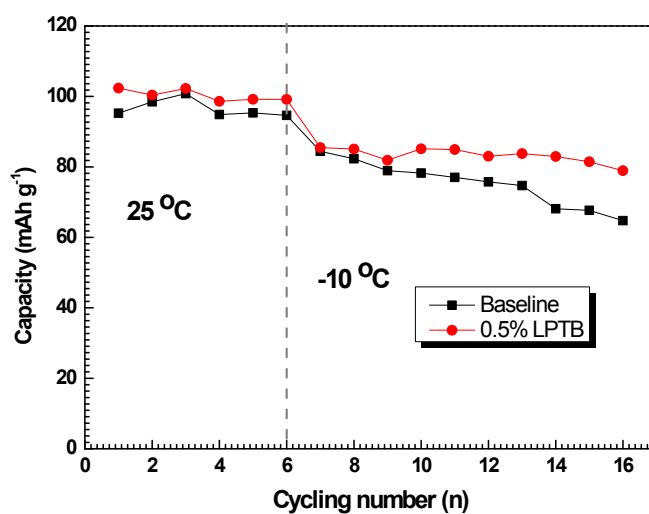


Fig. S4 Cycling performance of cells with and without 1% LPTB at 25 and 55 °C

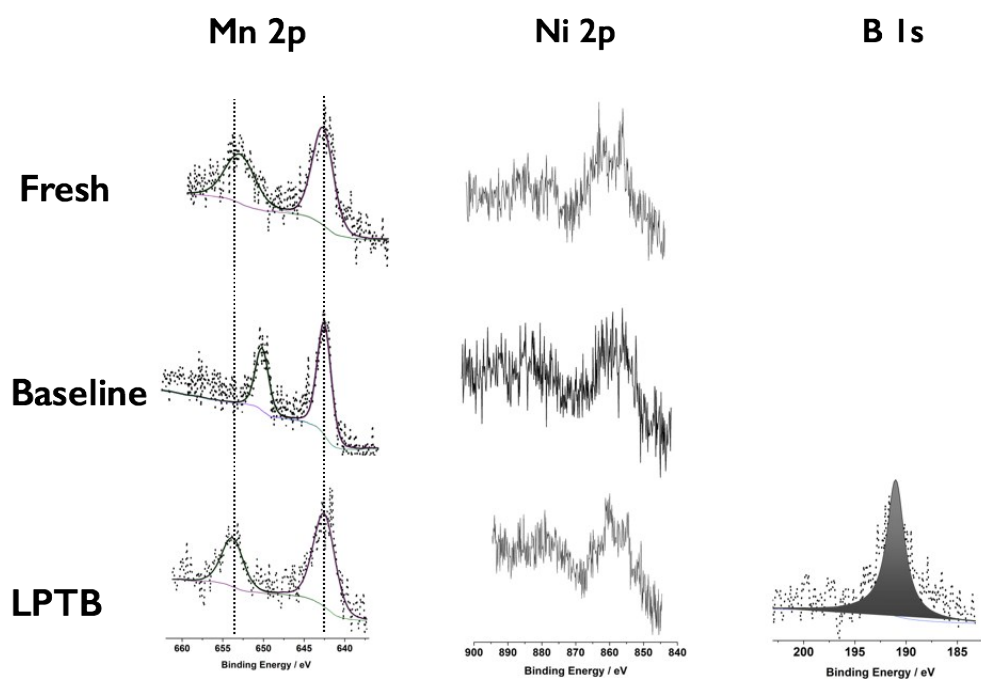


**Fig. S5** Rate performance of graphite/  $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$  cells at 25 °C with and without lithium 4-pyridal trimethyl borate additive electrolytes.

**Fig. S5** shows the rate performance of graphite/ $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$  cells with and without the additive. After formation cycles, cells were cycled at various rate, C/5, C/2, 1C, and C/5 again. Cells containing lithium 4-pyridal trimethyl borate deliver slightly higher capacity than that with baseline electrolyte, which indicates that incorporation of the additive does not adversely affect the ionic conductivity of the electrolyte. This is consistent with the slightly enhanced cycling performance at low temperature, as shown in **Fig. S6**. Cells are charged at room temperature, and discharged at -10 °C. Cells with 0.5% lithium pyridine trimethyl borate as additive displayed better cycling performance than the cells with standard electrolyte.



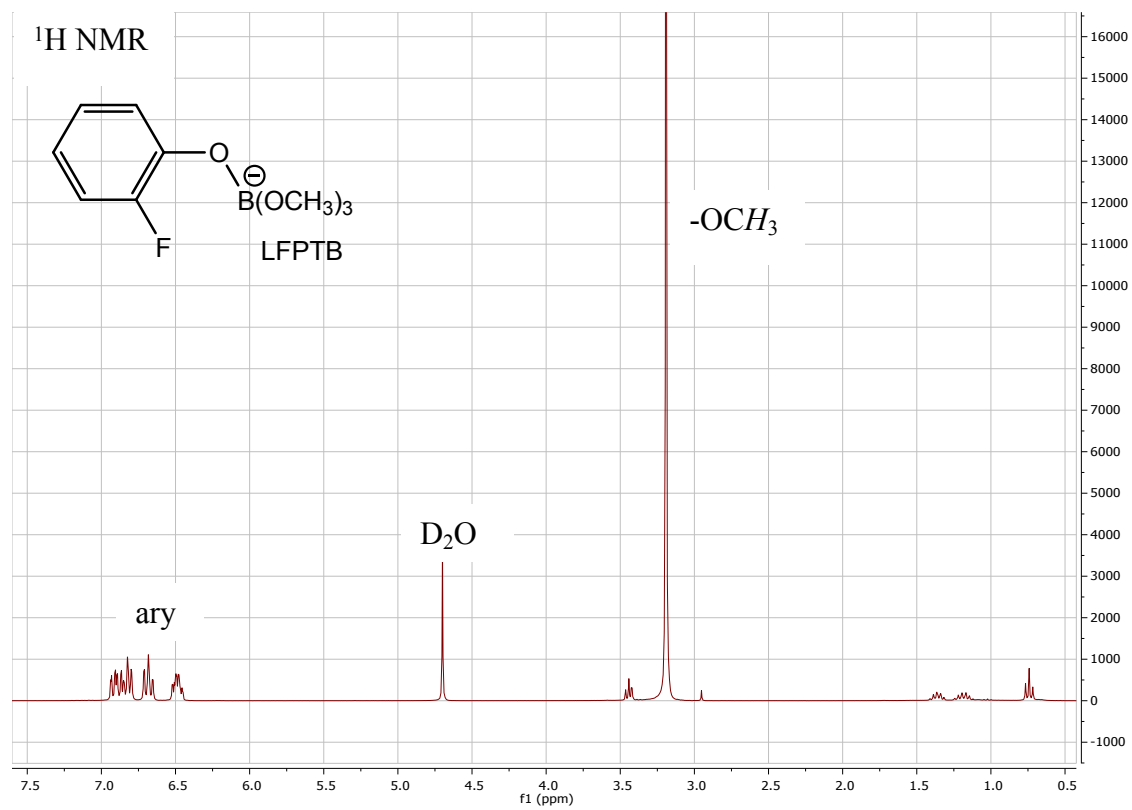
**Fig. S6** Low temperature performance of graphite/  $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$  cells containing electrolyte with and without added lithium 4-pyridal trimethyl borate.



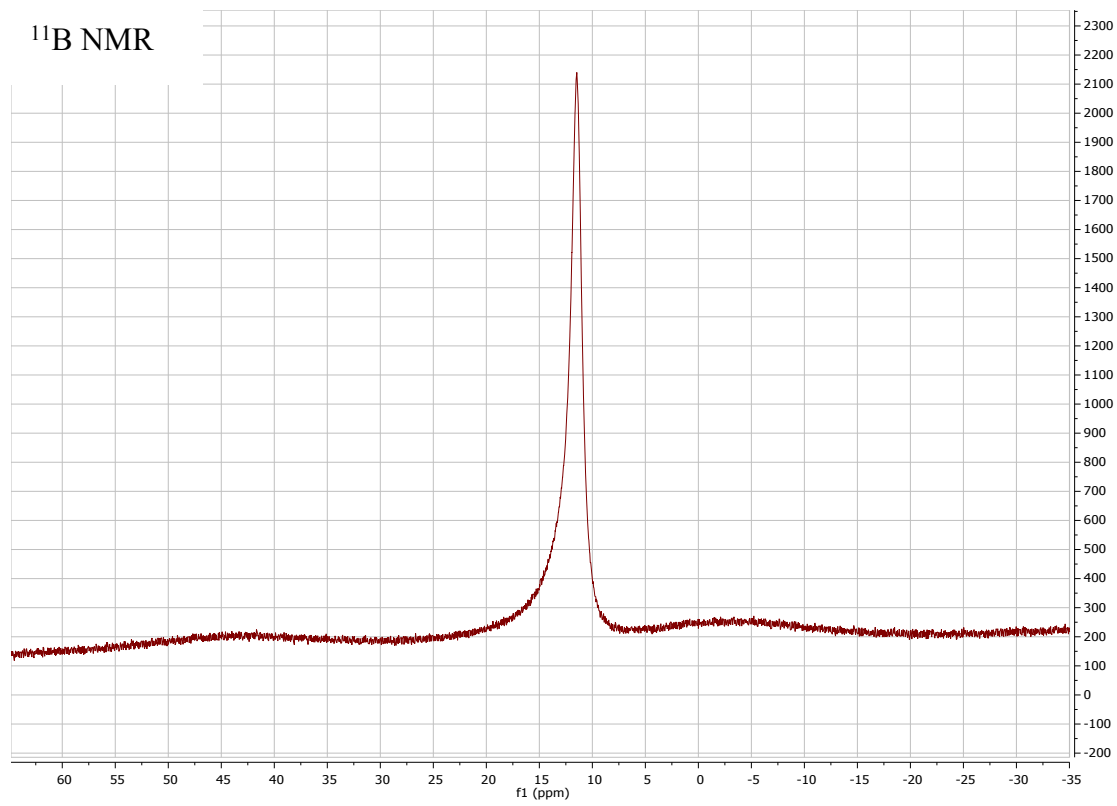
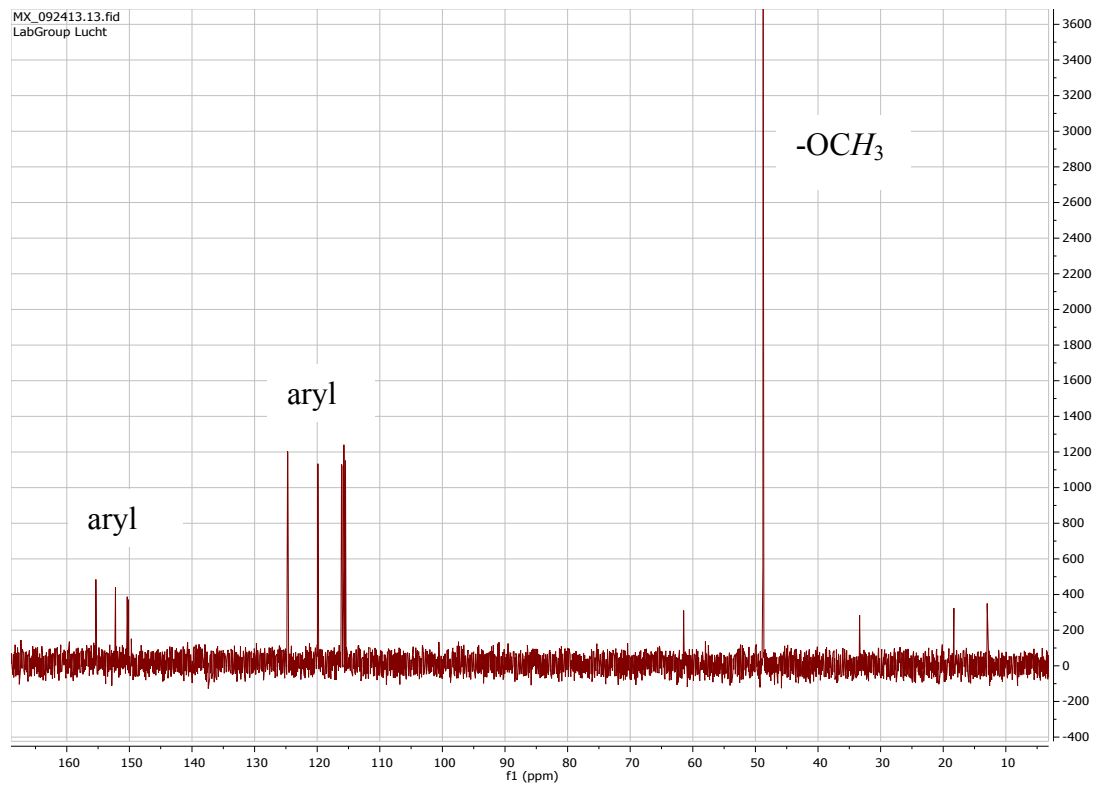
**Fig. S7** XPS spectra of Mn 2p, Ni 2p, and B 1s of the fresh cathode, cathode cycled in baseline electrolyte, and cathode cycled in LPTB added electrolyte.

## NMR Spectra of Lithium Borates

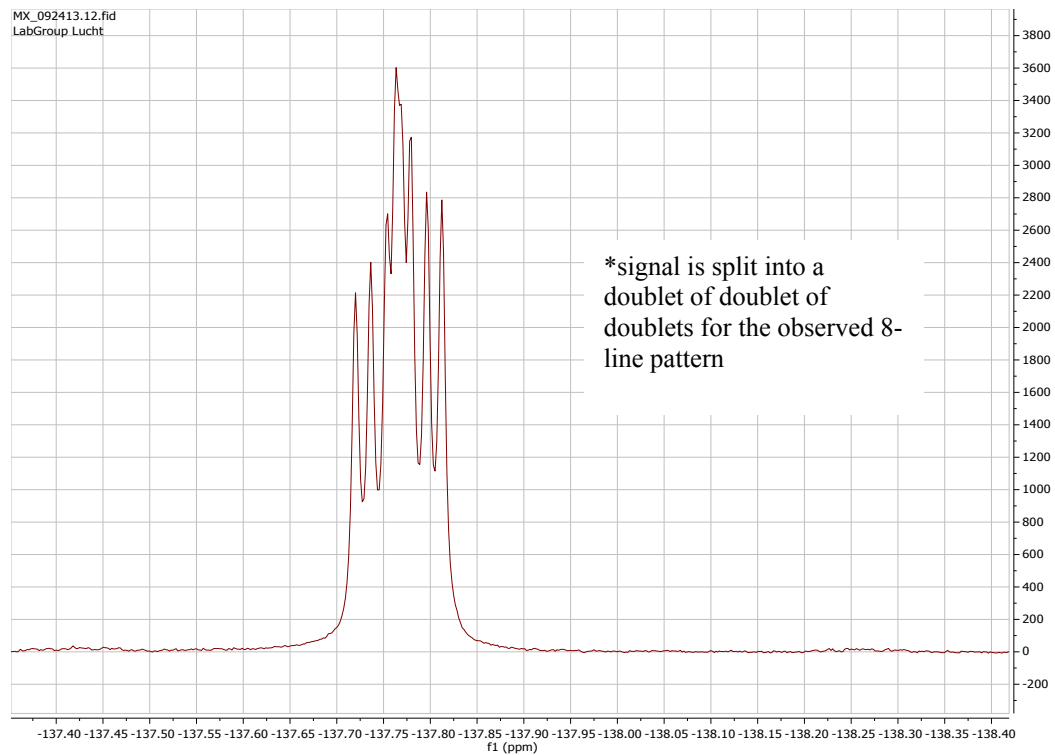
### Lithium 2-fluorophenol trimethyl borate (LFPTB).



<sup>13</sup>C NMR



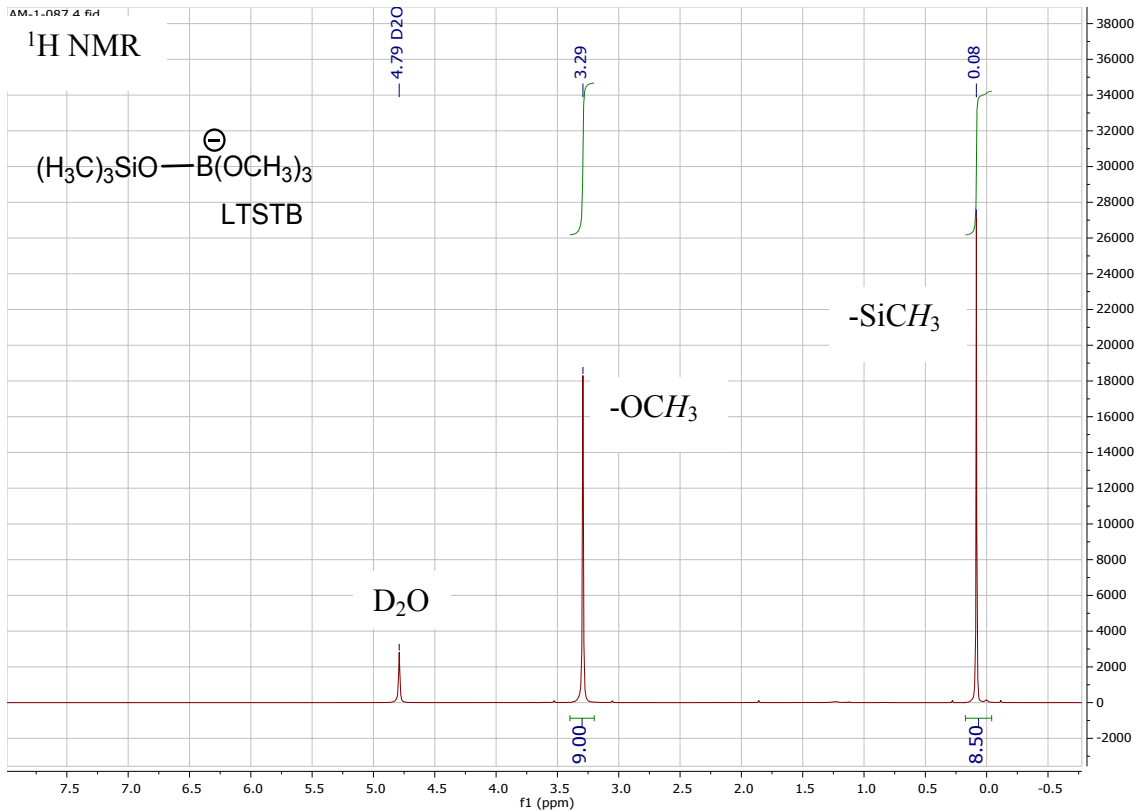
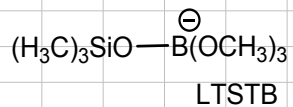
$^{19}\text{F}$  NMR



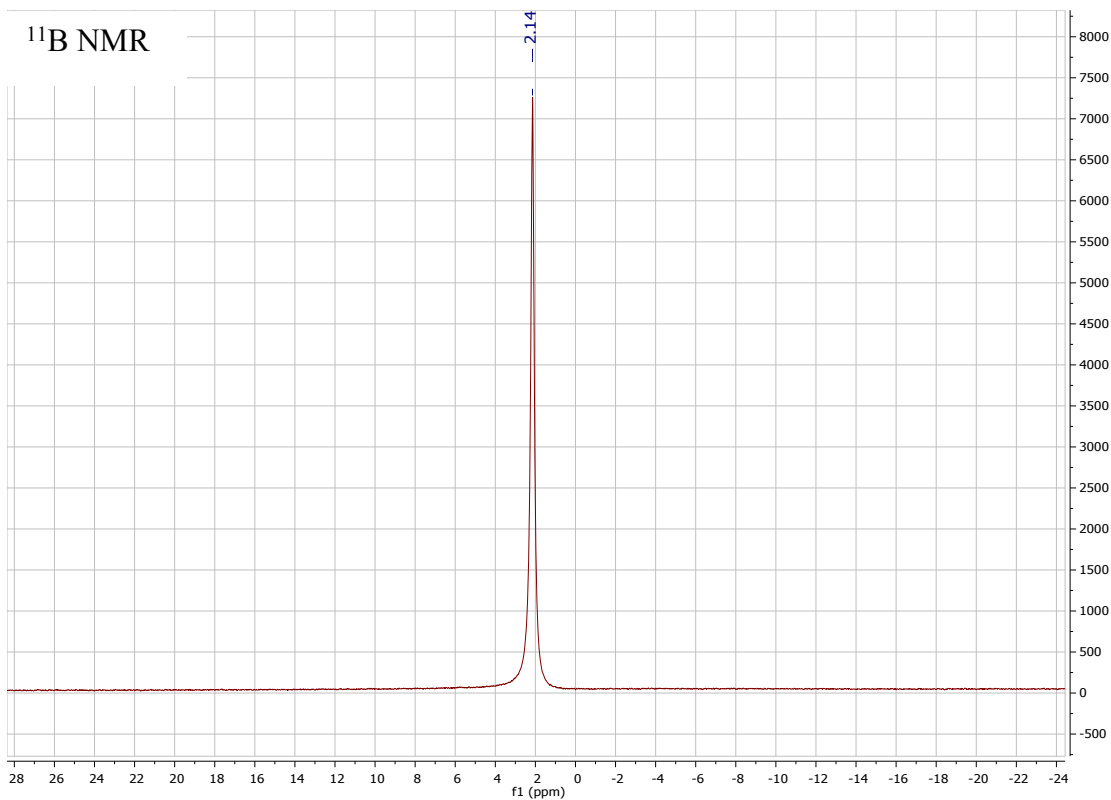
**Lithium trimethylsilyl trimethyl borate (LTSTB).**

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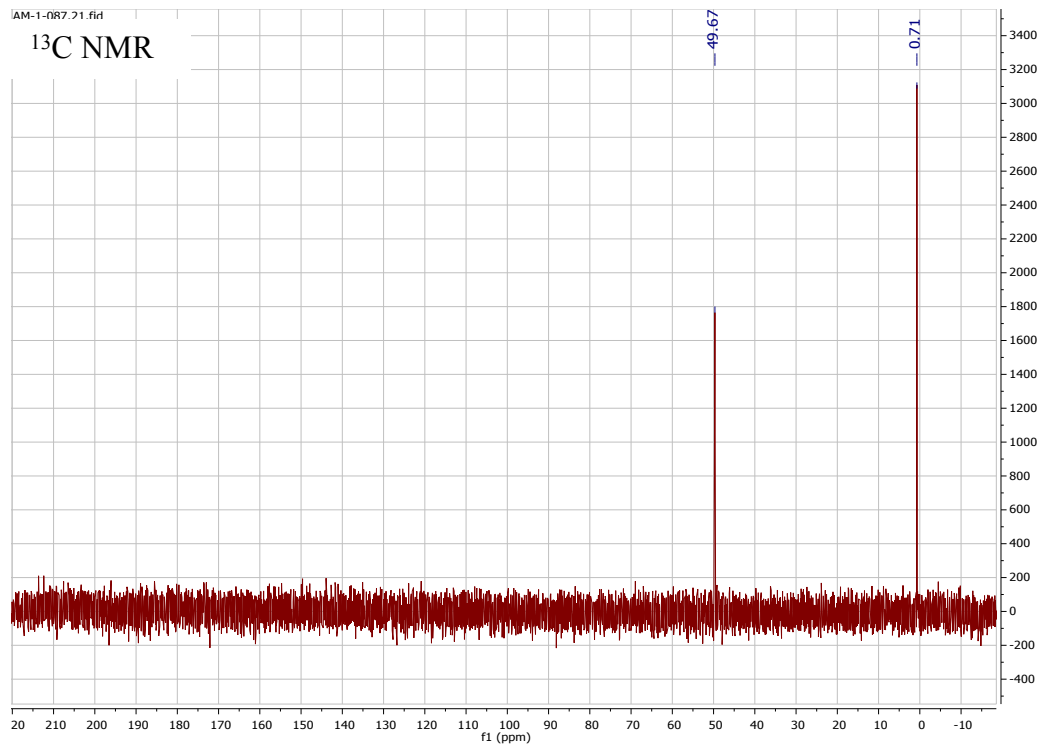
### $^1\text{H}$ NMR



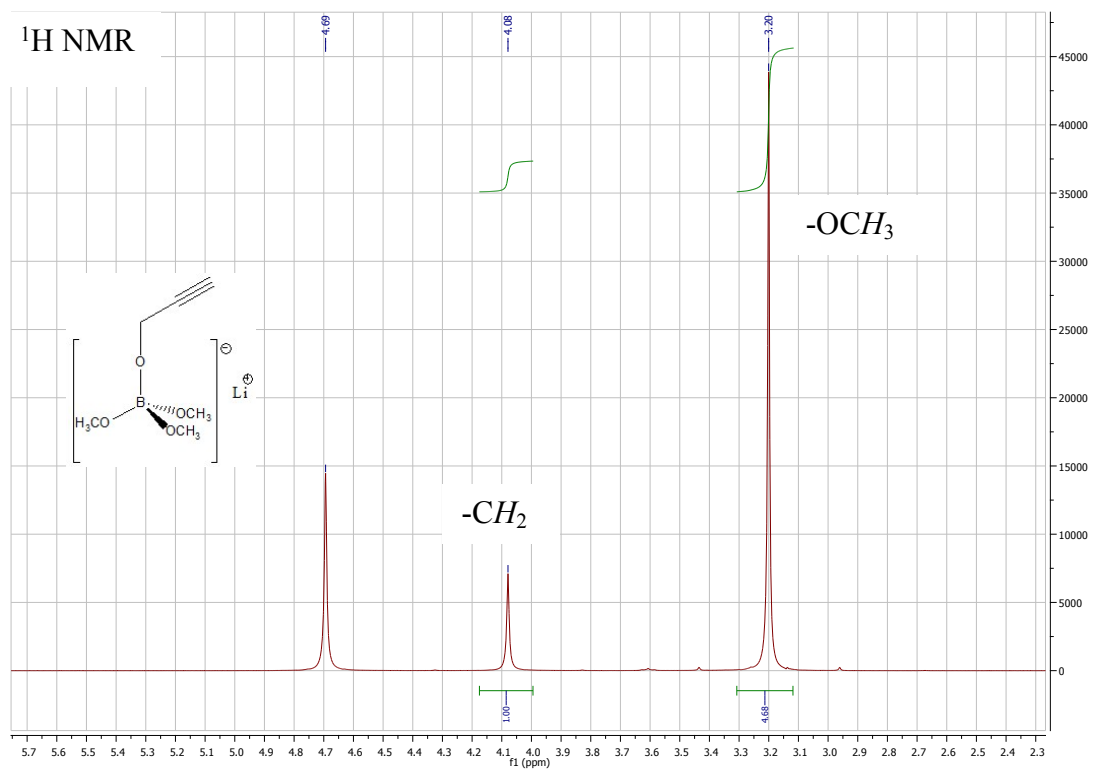
### $^{11}\text{B}$ NMR







**Lithium propargyl trimethyl borate (LPrTB).**



$^{11}\text{B}$  NMR

