Nuclear Magnetic Resonance spectroscopy is especially useful for the characterization of the chemical nature of the environments of $^7$Li spins. In materials like LiVPO$_4$F, the structure seems well ordered, as seen by XRD or TEM, however, $^7$Li NMR spectroscopy shows that 10-20% of the lithium content is in a different environment than the crystallographic site. Dipolar correlation experiments show that these lithium atoms are within a nanometer of the main site, and therefore are defects within the structure.

On the other hand, pulsed field gradients can also provide the positions of $^7$Li spins in space. This feature is the key to the success of MRI of working batteries. Moreover, the spectra of the cathodes and anodes in a working battery can be separated in situ by PFG-NMR, and the power of spectroscopic imaging is demonstrated in a LiCoO$_2$/Li$_4$Ti$_5$O$_12$ battery. In favorable cases, the lithiation front can be observed in thick electrodes with a 100 μm resolution, highlighting the limitation in lithium transport in electrodes with porosity issues.