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Materials Poster Abstract

X-Ray and Raman studies on all-solid-state Li-S batteries built around $LiBH_4$ solid electrolyte

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Efficient energy conversion and storage is crucial for development of systems based on renewable energy sources. For electricity storage, Li-ion batteries are commonly used in electronics devices but require many improvements to obtain longer life-time and higher energy densities. The current use of organic liquids and gels electrolytes limits these improvements because of lithium dendrites formation, reducing the lifetime of the battery and which can possibly be hazardous due to risks of short circuits.

Many alternatives to current state-of-art lithium-ion batteries exist; among them are lithium-sulfur solid-state batteries, solid electrolytes having higher stability when compare to liquid electrolytes, with no risks of vaporization and leakage while sulfur cathodes have large theoretical energy density. $LiBH_4$ is a promising material for solid-state batteries as it is lightweight and stable electrochemically at least up to 6 V. While the orthorhombic phase (P*nma*), stable at room temperature has a low ionic conductivity (~10^{-5} mS cm^{-1} at 30 ˚C), the hexagonal phase (P63/*mmc*), stable above 110 ˚C, has a much higher ionic conductivity (~1 mS cm^{-1} at 120˚) [1]. Confinement of $LiBH_4$ in mesoporous SiO_2 allows obtaining fast ionic conductivity even at room temperature.

We have successfully built and cycled solid-state lithium-sulphur batteries based on LiBH4 and have performed in operando X-ray diffraction, -tomography and Raman spectroscopy measurements on capillary cells of 1 mm in diameter. Figure 1 shows a capillary cell with an image obtained from X-Ray tomography. Figure 2 shows Raman spectra of $LiBH_4$ in a capillary cell. X-Ray and Raman data deliver information on the electrochemistry of the battery helping to understand and improve the battery performances.

Figures on next page

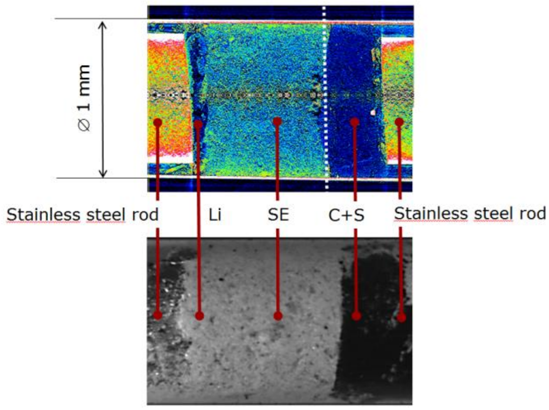

Figure 1.
Li-S capillary cell – X-Ray tomography

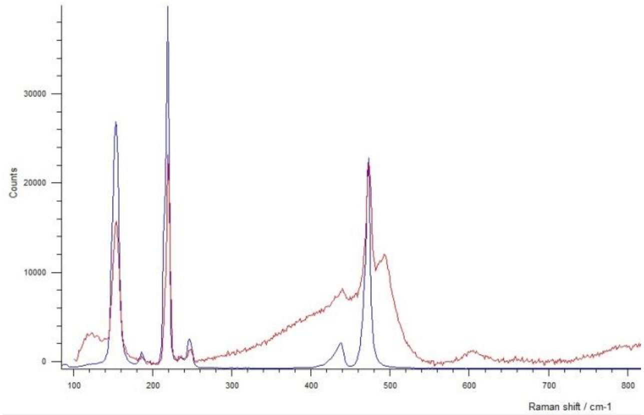

Figure 2.
Raman spectrum of sulphur in a capillary cell after discharge (red) compared to pristine sulphur (blue)

References

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