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Towards the industrialization of solid-state batteries: Impact of dry room exposure on sulfide-based solid electrolyte materials

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All-solid-state battery technology stirs great interest in the battery community and beyond. Sulfide-based solid electrolytes are attracting particular attention, mostly because of their unrivaled ionic conductivity. [1] However, because of their high sensitivity to moisture – they release toxic H₂S when in contact with water – most studies in the literature have, understandably, studied these materials in Argon-filled gloveboxes. If sulfide-based solid-state batteries came to be produced at industrial scale, the use of dry rooms as a production environment would be much more advantageous than a completely inert atmosphere. [2]

At the Battery Processing and Prototyping team of the CEA in Grenoble, we are currently studying how this type of technology could be scaled-up and in which environment. For this, we have exposed sulfide-based solid electrolytes to a typical dry room atmosphere and investigated the impact on operator safety and material characteristics and performance.

During the exposure of sulfide materials Li₆PS₅Cl, Li₇P₃S₁₁ and Li_{5.8}PS_{4.8}Cl_{1.2} to the dry room atmosphere, the kinetics of H₂S production were followed thanks to accurate laser detection. An array of physico-chemical characterisation techniques (X-ray diffraction, Raman spectroscopy, electrochemical impedance spectroscopy, scanning electron microscopy and X-ray photoelectron spectrometry) was then used to shed light on the degradation mechanisms. Finally, the electrochemical characteristics of solid-state LiIn-NMC cells containing pristine and exposed sulfide material were compared.

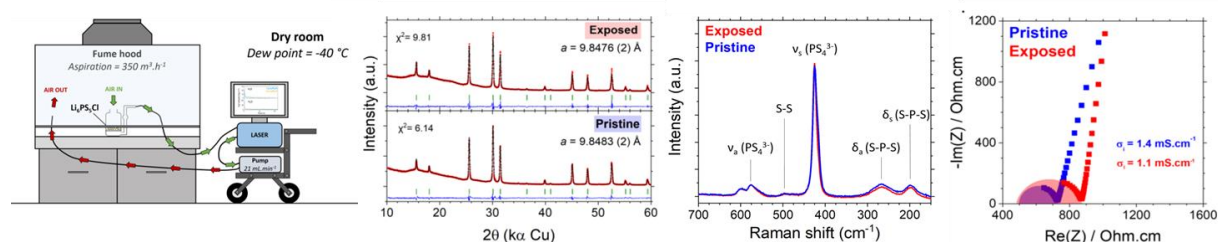


Figure 1. Exposition of sulfide electrolyte to dry room atmosphere and physico-chemical characterization

References

- [1] C. Yu, F. Zhao, J. Luo, L. Zhang, X. Sun, *Nano Energy*, **83** (2021), 105858.
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