

**PhD position at IFP Energies nouvelles (IFPEN) & LEPMI
Laboratory**
in Chemical Science

**Influence of thiophosphate solid electrolyte
particles, towards a comprehensive design of all
solid-states batteries**

All solid states Li batteries offer the promise of surpassing the energy density limits of current generations, thanks to the combined use of a solid electrolyte (SE) and a lithium metal anode. The key to this system lies in the choice of electrolyte and its integration into the cell. Among the SE studied, thiophosphates are very promising due to their excellent ionic conductivity and their ability to be densified at room temperature. However, the increase of energy density depends on the composite cathode (cathode active material, SE and carbon additive) and its delivered capacity. This implies that the mixture of the constituents and the physical contacts in between must be optimal to favor electronic and ionic transport paths. One of the main levers is the particle size and morphology of SE. Reducing the particle size of thiophosphates has already led to an increase of the capacity, but such reduction is mainly achieved by post-synthesis treatments resulting in lower ionic conductivities. In a previous a PhD work, new synthesis methods were developed which yielded a panel of Li_3PS_4 particles with different sizes and morphologies. The aim of this PhD is to study the influence of the morphology and the size of Li_3PS_4 particles to optimize the electrochemical performances of cathodes. You will be in charge of reproducing the synthesis of Li_3PS_4 particles and formulating composite cathodes. A combination of electrochemical measurements and post-mortem characterizations (SEM on FIB sections/X-ray micro-tomography) will allow you to guide the choice of SE to design high-performance cathodes. The aim will then be to adjust the synthesis conditions to get closer to the optimum solid electrolyte particles.

Keywords: Lithium all solid-states batteries, solid electrolyte, cathode, thiophosphate, sulfides

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PhD location	IFPEN, Lyon, France et LEPMI, Grenoble, France
Duration and start date	3 years, starting in the fourth quarter 2025 (Novembre 3)
Employer	IFPEN
Academic requirements	University Master degree in electrochemistry, chemistry, materials science
Language requirements	English level B2 (CEFR)
Other requirements	Previous experience of working with batteries and knowledge of working with inert atmospheres would be an advantage.

To apply, please send your cover letter and CV to the LEPMI & IFPEN supervisor indicated here above.

About IFP Energies nouvelles

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