



HAL
open science

Large-scale exploration of the LiSiPON system using a high throughput experimental method

William Berthou, Maxime Legallais, Gunay Yildirim, Bruno Bousquet, Stéphanie Sorieul, Vincent Motto-Ros, Brigitte Pecquenard, Frédéric Le Cras

► To cite this version:

William Berthou, Maxime Legallais, Gunay Yildirim, Bruno Bousquet, Stéphanie Sorieul, et al.. Large-scale exploration of the LiSiPON system using a high throughput experimental method. 245th ECS Meeting, May 2024, San Francisco, United States. pp.455, 10.1149/MA2024-012455mtgabs . cea-04719784

HAL Id: cea-04719784

<https://cea.hal.science/cea-04719784v1>

Submitted on 3 Oct 2024

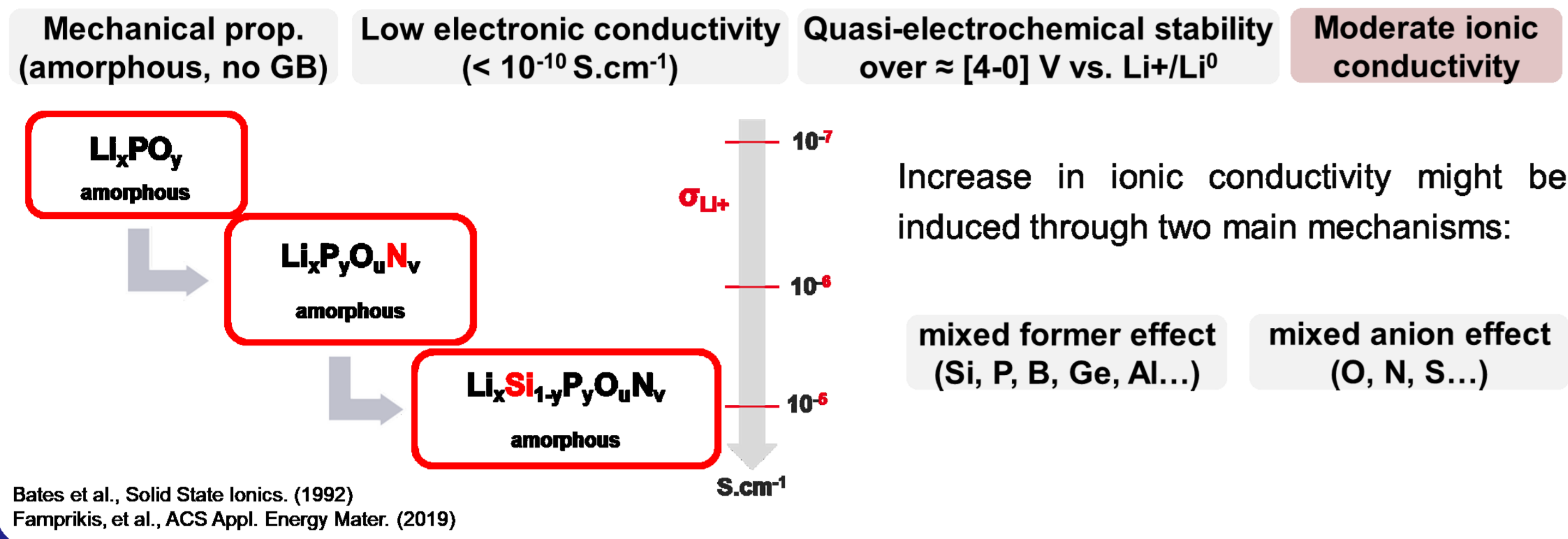
HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Large-scale exploration of the LiSiPON system using a High-Throughput Experimental approach

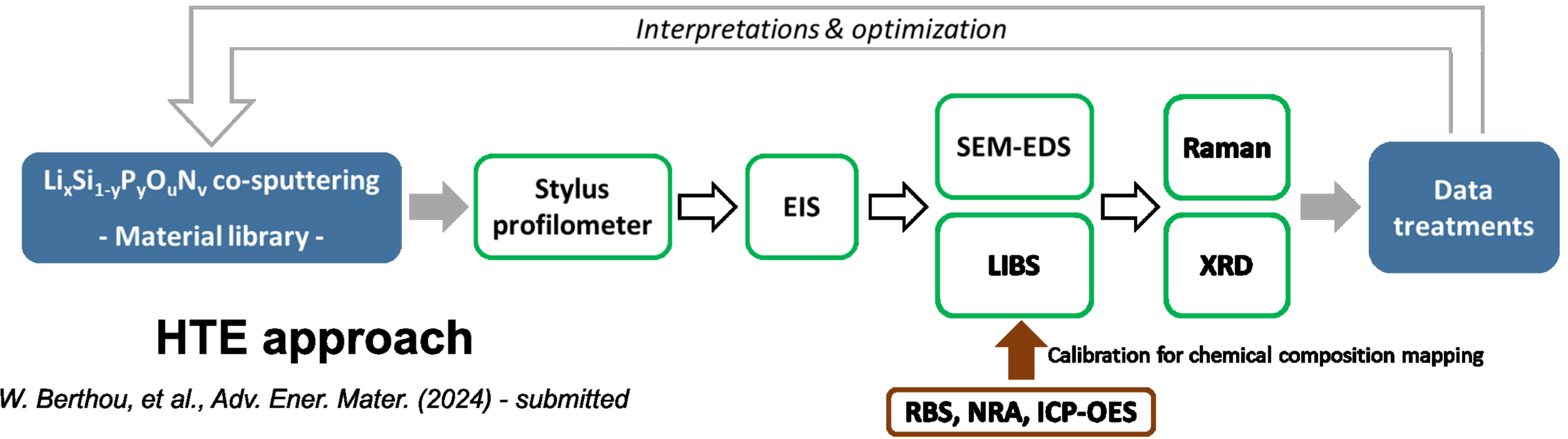
1. Introduction to HTE approach

Amorphous lithium phosphates are used since 25 years as state-of-the-art solid electrolyte into all-solid-state thin film micro-batteries. Those materials are worth of interest for their use as artificial SEI-CEI into All-Solid-State Lithium Batteries (Li-ASSB) :



There is a place for a new paradigm, beyond 'try & errors' methods. High Throughput Experimentation (HTE) aims at coupling combinatorial methods (synthesizing wide material libraries) and automated, fast characterization techniques. In material science, it might accelerate the discovery of breakthrough materials by the study of complex systems (ternary, quaternary...).

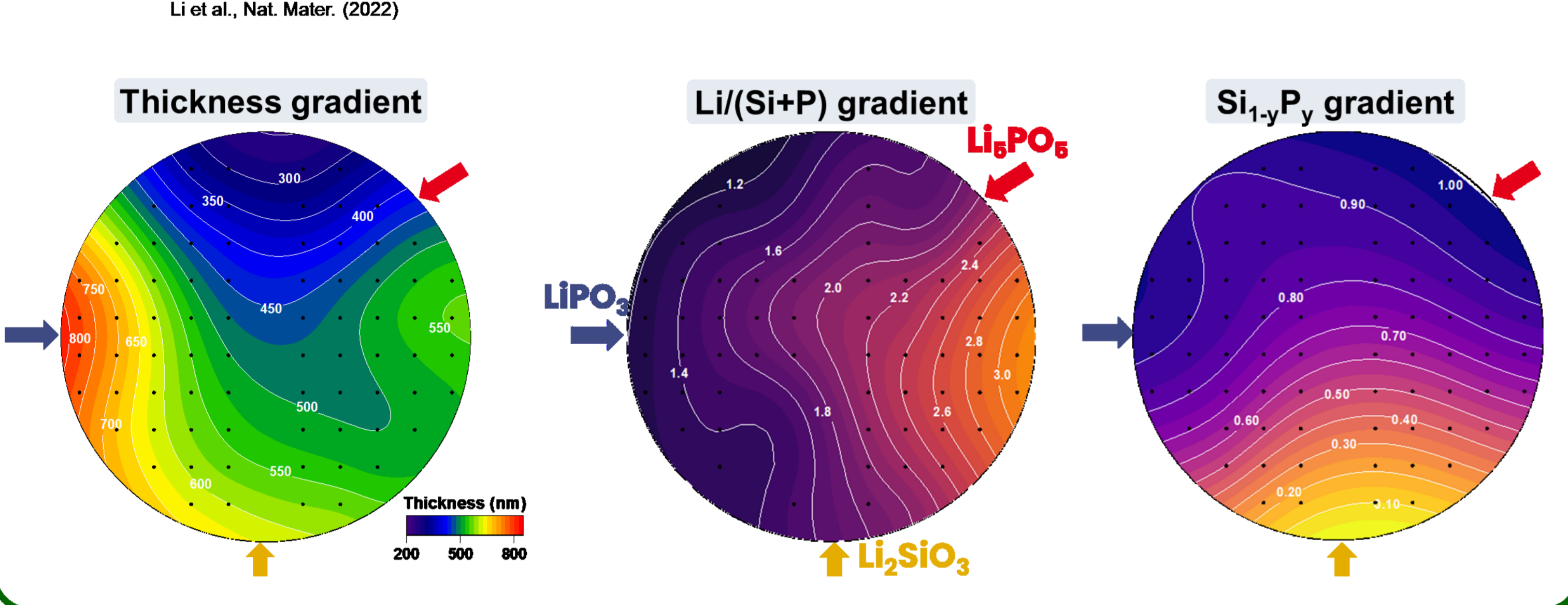
In this context, a HTE approach has been developed targeting solid ionic conductors :



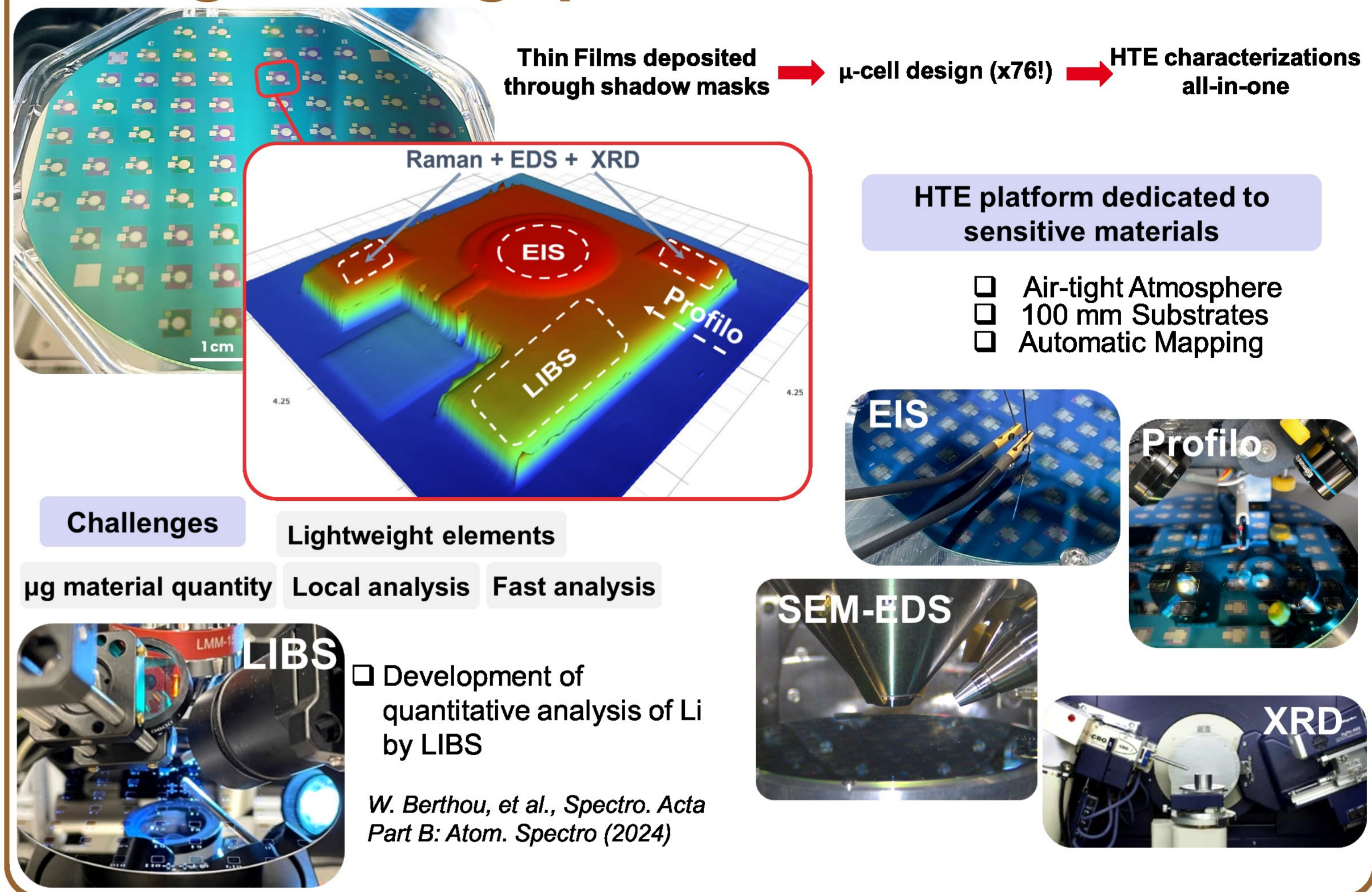
2. Combinatorial synthesis of thin films

A way to achieve combinatorial synthesis is through co-sputtering. The PVD process owns interesting advantages i) simple/robust approach compared to other CS methods, ii) continuous composition & thickness gradients and iii) homogeneous batch of sample regarding synthesis parameters.

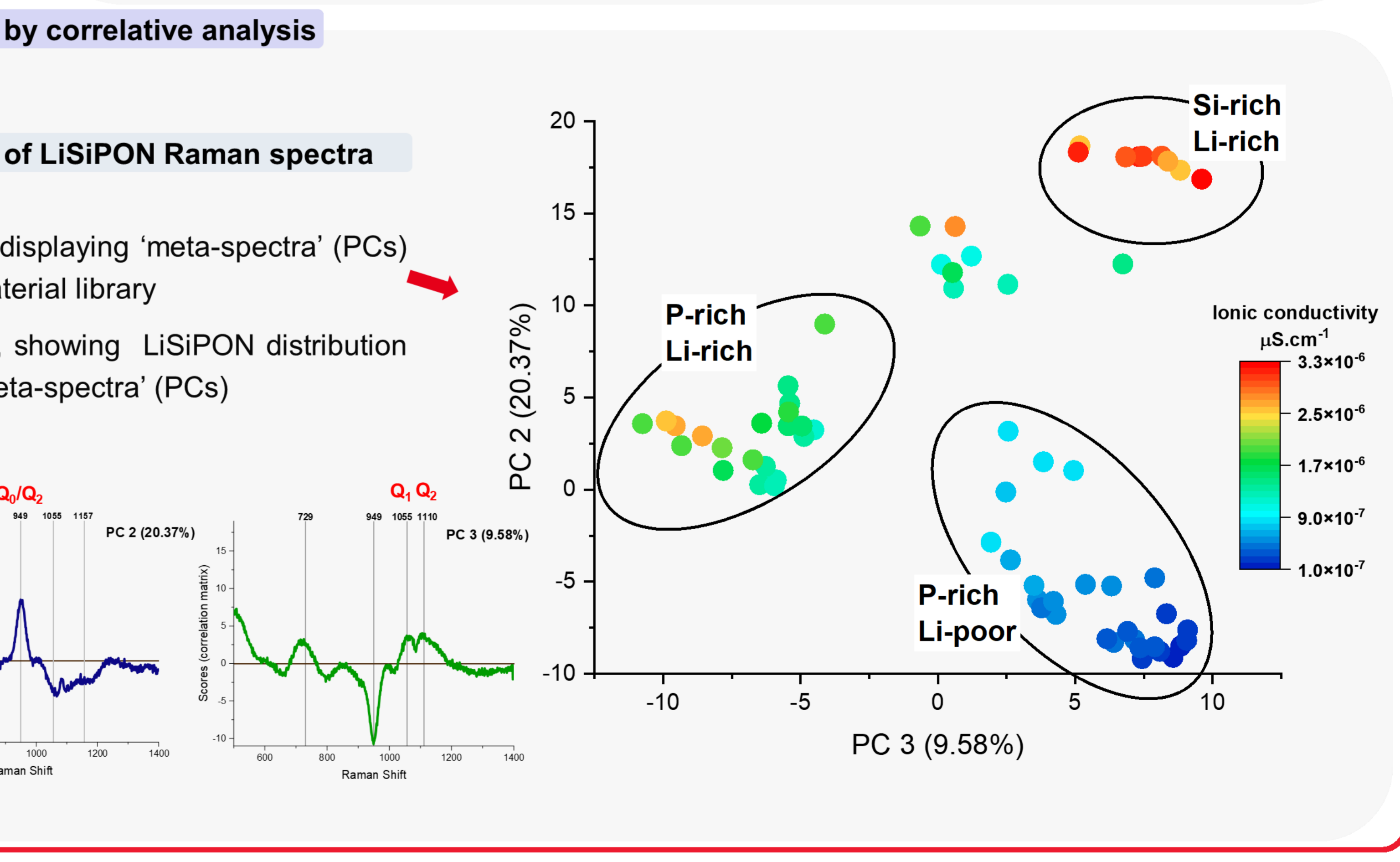
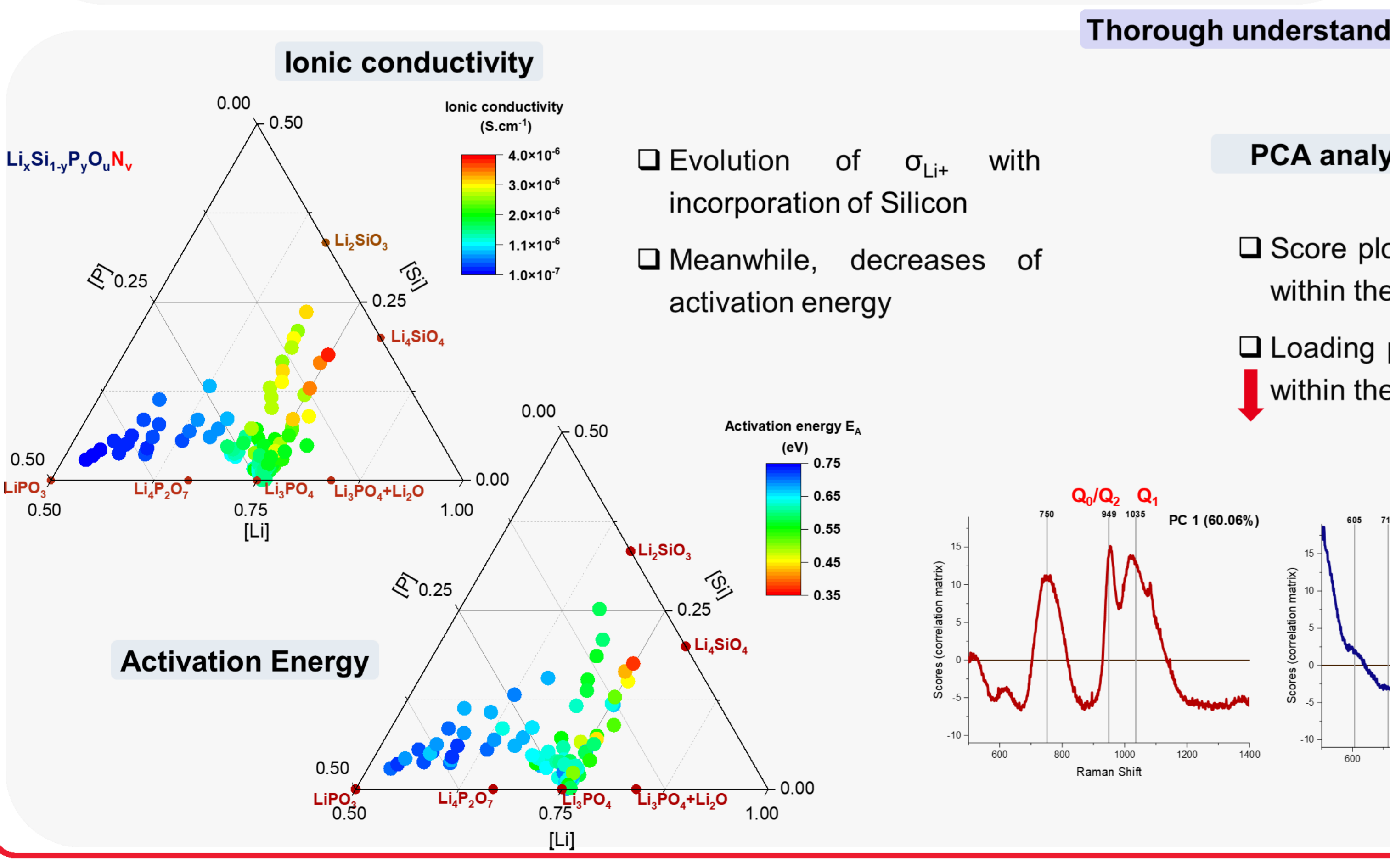
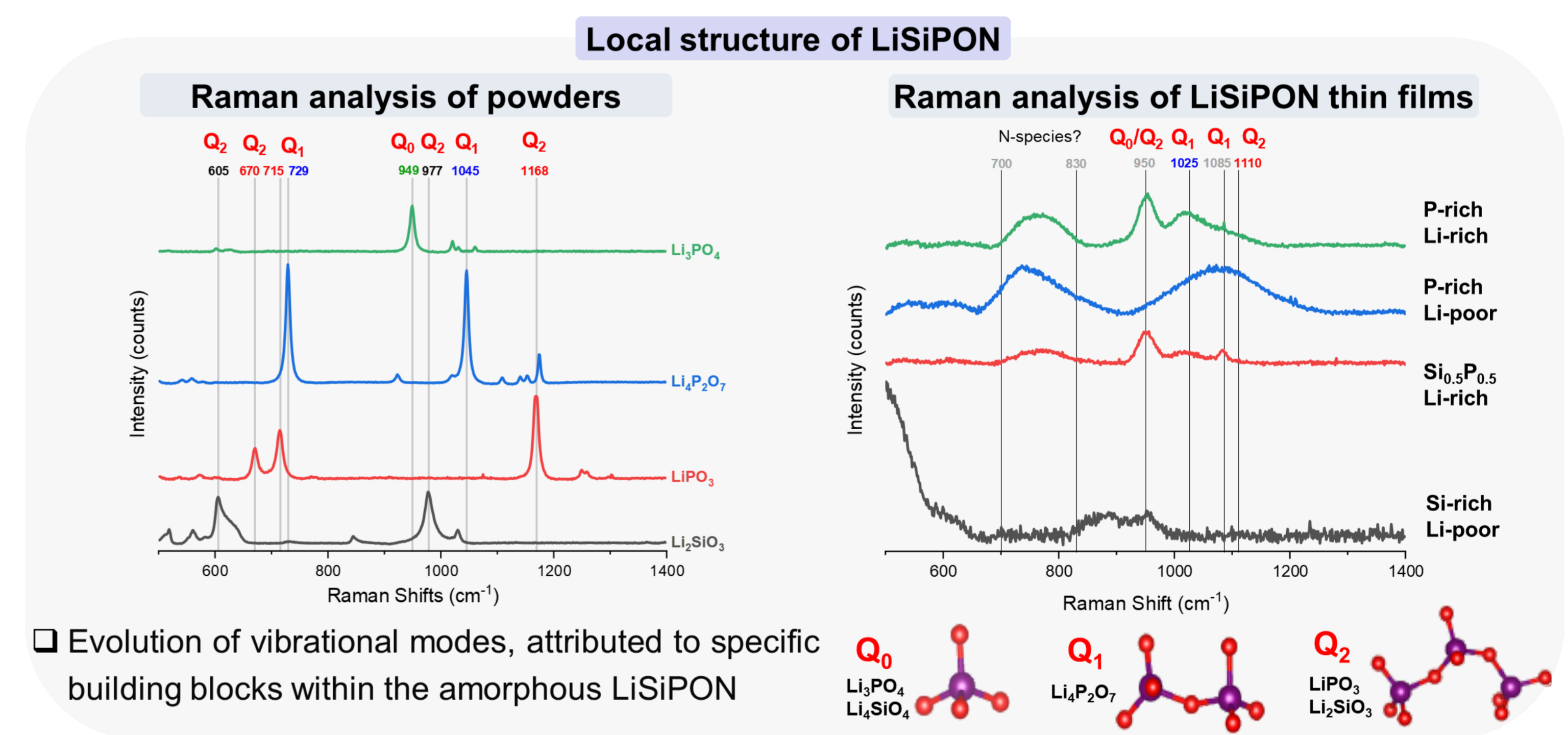
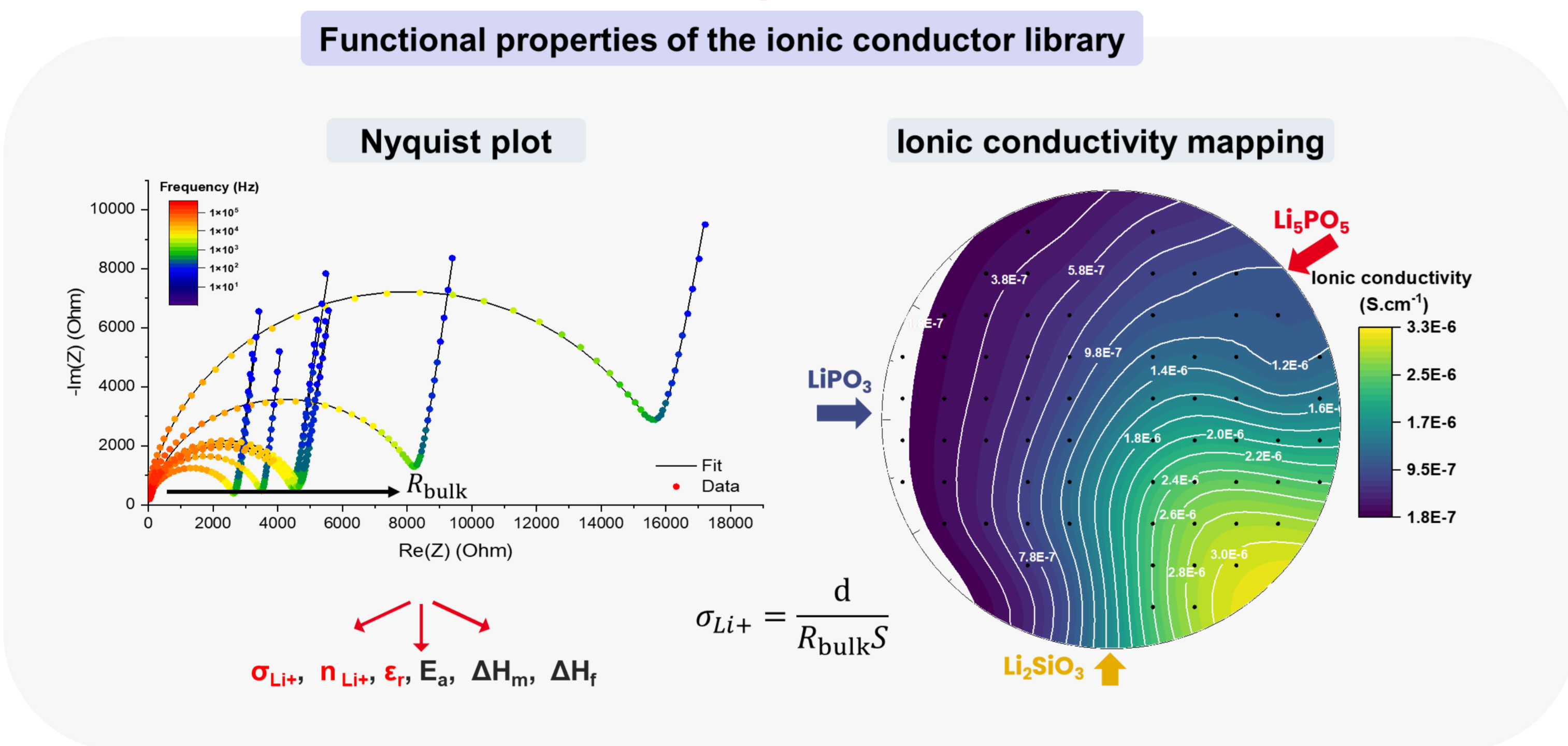
The Li_xSi_{1-y}P_yO_nN_v library is prepared on a 4" substrate by the co-sputtering of LiPO₃, Li₅PO₅ and Li₂SiO₃ under pure N₂ atmosphere. The material library comprises thickness and composition gradients.



3. High-throughput characterizations



4. Correlative study of composition-structure-functional properties



5. Take Home Message

- All-in-one HTS platform for characterization of solid ionic conductors
- Screening of chemical – structural – functional properties of LiSiPON thin films library deposited by combinatorial sputtering
- This correlative study provides new insight about the role of Li and Si incorporation in oxynitride phosphorus media, in terms of material structure and ionic conductivity

Acknowledgments

The authors thank Region Nouvelle Aquitaine (France) for the financial support.

In addition, we thank the AIFIRA facility, being financially supported by the CNRS, the University of Bordeaux and the Région Nouvelle Aquitaine. We thank the technical staff members of the AIFIRA facility P. Alfaut, J. Jouve and S. Sorieul.

William Berthou^{1,2}, Maxime Legallais¹, Gunay Yildirim¹, Bruno Bousquet², Stephanie Sorieul³, Vincent Motto-Ros¹, Frédéric Le Cras^{2,5}

¹ Univ. Grenoble Alpes, CEA, CTREG, DNAQ, 28 Avenue Gustave Eiffel, 33600 Pessac, France
² CNRS, Univ. Bordeaux, Bordeaux INP, ICMCB – UMR 5026, 87 Av. du Dr Schweitzer 33608 Pessac, France
³ Université Bordeaux, CNRS - LP2IB, CENBG, Gradignan, France
⁴ Univ. Lyon, Université Claude Bernard Lyon 1, CNRS, UMR5306, Institut Lumière Matière, Villeurbanne F-69100, France
⁵ Univ. Grenoble Alpes, CEA, LITEN, 38054 Grenoble, France