Conversion metal fluorides, solid-state electrolytes & metal-organic/ceramic nanowires for next-generation Li-ion batteries

The emergence of Li-ion batteries (LIBs) is truly fantastic with a predicted rise in over hundreds of GWh y^{-1} in the next 5-10 years with them being the main power supply for electric vehicles and portable electronics. Underpinning the success of this technology is the design of non-toxic, non-flammable, mechanically robust yet high energy density and specific energy materials made of abundant elements.

In the first part of our talk, we will discuss conversion metal fluorides to meet the future demand for electric transportation. We will present our strategy to overcome the challenges of conversion electrodes such as cathode dissolution, mechanical degradation, and undesirable electrolyte decomposition.

Then, we will propose to explore low-melting-point, easy accessible Li hydroxyl halides solid-state electrolytes of a generic Li_2OHCl composition and unravel their microstructure, composition, processability into commercial grade cathodes, and a role of the proton on ionic conductivities.

Finally, we will demonstrate the technology of the de-alloying of bulk Al-Li alloys in alcohols which gives ultra-long metal-organic aluminum oxoalkoxides nanowires, which are further converted on heating to the aluminum oxide ceramic nanowires to be used as battery separators. At the frontier of this technology is a mechanism of the minimization of strain energy of binary metal alloys at the boundary of phase transformation, which leads to the elastically strained 1D reaction products.