A new material for the battery of the future

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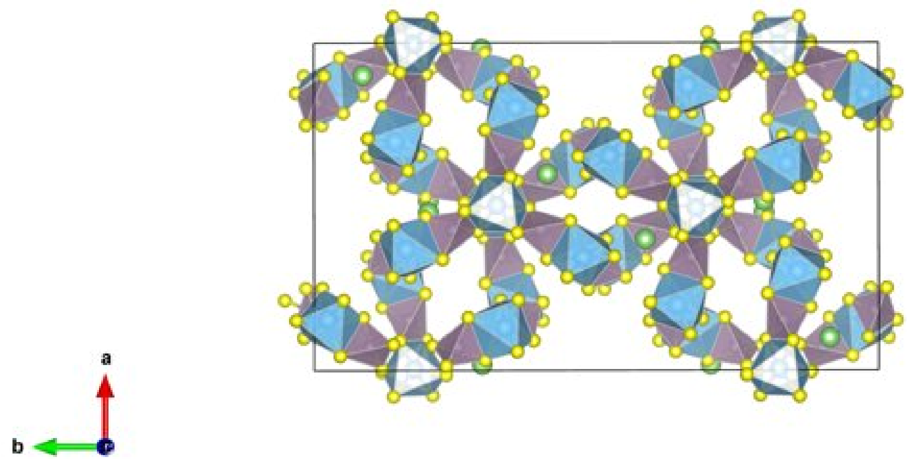

UCLouvain's researchers discovered a new high performance and safe battery material (LTPS) capable of speeding up charge and discharge to a level never observed so far. Credit: University of Louvain (UCLouvain)

Renewable sources of energy such as wind or photovoltaic are intermittent; production peaks do not necessarily follow the demand peaks. Storing green energy is therefore essential to moving away from fossil fuels. The energy produced by photovoltaic cells and wind power is stored to be used later on when needed.

Li-ion technology is currently the best-performing technology for energy storage based on batteries. Li-ion batteries are used in small electronics (smartphones, laptops) and are the best options for electric cars. Their drawback? Li-ion batteries can catch fire, for instance, because of manufacturing problems. This is due in part to the use of liquid organic electrolytes in current batteries. These organic electrolytes are necessary to the battery, but highly flammable.

The solution? Switching from a liquid flammable electrolyte to a solid (i.e., moving to all-solid-state batteries). This is a very difficult step, as lithium ions in solids are less mobile than in liquids. This lower mobility limits the battery performance in terms of charge and discharge rate.

Scientists have been looking for materials that could enable all-solid-state batteries. Researchers from UCLouvain have now discovered such a material, $LiTi_2(PS_4)_3$, or LTPS. LTPS has the highest lithium diffusion coefficient (a direct measure of lithium mobility) ever measured in a solid. LTPS shows a diffusion coefficient much higher than any known material. The results are published in *Chem*.

This lithium mobility comes directly from the unique crystal structure (i.e., the arrangement of atoms) of LTPS. This mechanism opens new perspectives in the field of lithium ion conductors, and beyond LTPS, opens an avenue toward the search for new materials with similar diffusion mechanisms. Further study and improvements to the material are required to enable its future commercialization. This discovery is nevertheless an important step in the understanding of materials with extremely high lithium ion mobility, which are ultimately needed for all-solid-state batteries of the future. These materials, including LTPS, could be used in many technologies, from cars to smartphones.

More information: Davide Di Stefano et al, Superionic Diffusion through Frustrated Energy Landscape, *Chem* (2019). DOI:

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