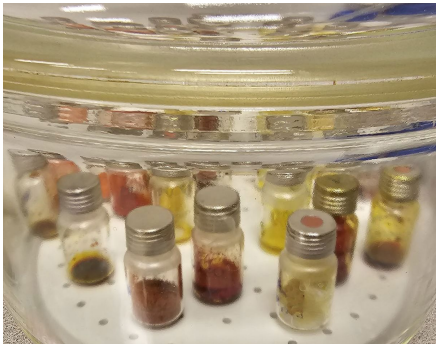
ASTRABAT

FLUORINE-FREE IONIC LIQUID PLASTICIZERS FOR ALL-SOLID-STATE LI-ION BATTERIES

The ASTRABAT project's aim is to develop all-solid-state Li-ion batteries. The most critical new component here is hybrid solid electrolyte, which has to contain plasticizer – an ionic liquid. Within the project, the new set of ionic liquids were synthesised which improve electrolytes far above the state-of-the-art and are fluorine-free.

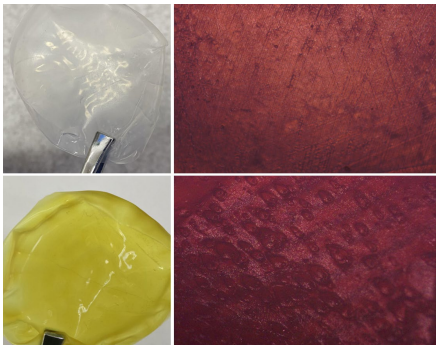
The project's work yielded a set of new fluorine-free ionic liquids developed at the Warsaw University of Technology (WUT). Ionic liquids are salts that are liquid at the room temperature or melt slightly above room temperature. They consist exclusively of ions and are usually at least partially dissociated. As ionic liquids maintain the freedom of ion movement, they conduct ionically. Unlike typical electrolytes, ionic liquids do not contain any solvent or other volatile material, so they do not have any vapour pressure. This makes them very safe – they are not flammable and also do not form any vapours regardless of the temperature (unless they decompose at very high temperatures). The latter cause them to be safe under high and low pressures (vacuum, high altitude). It also means they are more suitable for applications in transport (including air transport) and large scale energy storage than typical electrolytes.

Another advantage of ionic liquids is that they may be used as plasticizers for polymer materials instead of typical solvents. Such plasticized polymer materials are the basis for solid hybrid electrolytes. Solid hybrid electrolytes are the core of the next generation safe batteries for electric battery-based vehicles which are the medium-term target of the European Union.



Polymer materials, when plasticized, are more flexible and have a lower degree of crystallinity. The use of ionic liquids yields the same result as plasticization with other liquids, but does not cause polymers to be more volatile or flammable. It is particularly important for polymer electrolytes for new generations of lithium-ion batteries, where plasticization increases the conductivity of polymer electrolytes. Thus, ionic liquids have a significant role in the future industry of batteries for energy storage and transport

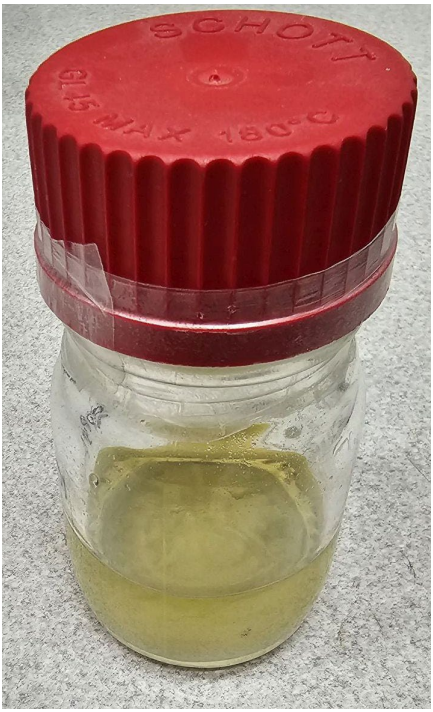
The ionic liquids developed within the ASTRABAT project have been designed to be good plasticizers for polymer electrolytes, while being fluorine-free materials. They are thus safer for energy storage, but also less harmful to the environment during battery manufacturing and during recycling.



The aim of the plasticization is to decrease the temperature of the high conductivity range of the hybrid polymer electrolyte used in all-solid-state lithium-ion batteries. This would allow much higher currents (higher power) to be available for electric vehicles powered by the batteries.
The EU's target for the conductivity of solid hybrid electrolytes is 0.2-0.4 mS/cm in the 20-50°C range. The state-of-the-art conductivities of hybrid/solid electrolytes are ca. 0.1 mS/cm above 40°C. ASTRABAT solid hybrid electrolytes containing new ionic liquids from WUT achieve ca. 0.3 mS/cm already at 20°C and up to 0.9 mS/cm at 50°C. The ASTRABAT ionic liquids themselves are stable up to at least 250°C, so they are suitable for typical polymer processing methods.

Other applications of ionic liquids include catalysis, solvents for selective reactions, solvents for separation techniques (chromatography, extraction, etc.), cleaning metallurgical products and others. Thanks to their lack of vapour pressure, they can be used and regenerated almost indefinitely as there are no losses due to evaporation, like with typical solvents. Also, no losses means no environmental pollution (no emission) when using ionic liquids in the industry.

The additional advantage of ASTRABAT ionic liquids is that they are fluorine-free – and better for the environment – they do not use critical raw material (fluorine). Thus, ionic liquids developed within the ASTRABAT project have multiple other possible applications beyond the scope of batteries.



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