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A New Class of Fast Alkali Ion Conductor: Inorganic Plastic Crystals

Background

Li-ion batteries allow us to store electrochemical energy efficiently and safely. Indeed, these batteries have revolutionized fields ranging from portable and wearable electronics to grid-scale energy supply. Typically, Li-ion batteries operate by polarizing and transferring lithium ions through organic solvents or gels. Unfortunately, these systems suffer from low conductivity and are potentially dangerous due to the flammable nature of the organic solvent. Other electrolytes have also been explored, but most are non-viable due to factors such as toxicity or poor performance at ambient temperatures. Therefore, an effective, long lasting electrolyte able to safely and effectively conduct electricity under ambient conditions is needed.

Invention Description

Researchers at Arizona State University have developed a novel electrolytic material. This material is highly ionically conductive, with conductivities comparable to the best commercially available electrolytes, yet having the structure of a plastic crystal. A plastic crystal is a soft, wax like material comprised of weakly interacting molecules which may have orientational or rotational freedom. Because this material operates similar to a solid-state system, there are fewer possible side reactions while also being non-flammable. The material is manufactured from inexpensive, earth-abundant elements and is easy to manufacture. Additionally, the polymorphic nature of the crystal reduces the likelihood of fracture or corruption of the solid-state structure, maintaining low interfacial resistance with electrode materials. Altogether, this electrolytic material addresses many of the weaknesses of conventional li-ion electrolytes while maintaining the same level of performance.

Potential Applications

- Lithium-ion batteries
- Fuel cells
- Supercapacitors
- Electronics (rugged, personal)

Inventors

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Benefits and Advantages

- Cost Effective – Simple and inexpensive materials and manufacturing processes
- Powerful – provides the highest conductivity
- Integration – Can be used in existing manufacturing processes
- Performance – Conductive material in the solid state; no possibility for side reactions; non-brittle solid plastic crystals are able to stay stable in most conditions, including molecular solvents known to encounter stability problems.