Q&A activity teacher's information

This Q&A section aims to consolidate the lower secondary college chemistry and modern technology information delivers at the Symposium on 4th May 2020.

Why do scientists invent Sodium battery?

Because there is decreased amount of Lithium on earth as people exploit it for commercial use. Sodium battery provides a solution before we use up the Lithium.

What are the advantages of Li-ion batteries?

They are well-developed in production chain.

High energy density compared with Sodium batteries.

Try to explain why Lithium battery has a higher energy density than Sodium battery from Periodic table?

Energy density is the amount of energy stored in a system per unit volume. Lithium locates at Group 1 period 2, above Sodium. As it moves down from the Period Table, atomic number increases. The size of Sodium atom is bigger than Lithium atom. For the same amount of energy produced, the larger the volume, the lower the energy density.

What are the disadvantages of Lithium battery?

There is a global shortage of metals like Lithium, Cobalt, and Nickel.

They are flammable, and volatile organic electrolyte.

Heavy metal pollution, such as Mn, Co, and Ni.

The recycle cost is high for the complex component in electronic-waste.

What are some of the benefits of using Na-ion batteries?

Inexhaustible availability, low cost

Safe, and stable solid electrolyte

High temperature operation range

What can be some of the drawbacks for Na-ion batteries?

They are relatively low in energy density.

Why even if Sodium ion batteries are low in energy density, they can still be widely used in industry? E.g. Tesla Powerwall, power grid

Because when we scale Sodium batteries up from laboratory to industry, density-volume is not the major problem any more.

Why is it necessary to add a separator between Anode and Cathode in Sodium-ion battery?

To prevent short circuit (big current and small resistance)that can damage the battery.

How to distinguish from anode with cathode in a generic battery?

Generally speaking, anode is the positive electrode, whereas cathode is the negative electrode. Things can be complicated here. During recharge, if the electrons flow into that electrode, it is anode; if the electrons flows out from that electrode, it is cathode. During discharge, things can be the opposite. If the electrons flow out of that electrode, it is anode, and the other side is cathode.

Where does Na+ move when the Sodium battery is being charged? Try to reason the fundamental mechanism behind it in chemistry.

Na+ moves from the cathode to the anode. Anode is the electrode where the current flows in, Na+ movement counterbalances the negativity produced by e- during the recharge.

What happens to Na+ once the battery is fully charged? And what happens to Na+ when the battery is discharging?

As explained in previous question, Na+ moves in the same direction as the electrons. It will stay at the anode once it is fully charged. During discharge, Na+ moves to cathode.

What are some of the advantages of using organic ionic plastic crystals (OIPC) electrolyte?

In general they have better performance and are safer, since they are more thermodynamically and electrochemically stable as compared to normal electrolyte. They are non-volatile and inflammable. Low vapor pressure. Fast ion conduction of target ion.

What is the fundamental mechanism that contributes to the advantages of OIPC?

As temperature increases, rotational motion occurs, causing disordered structure in OIPC. This disordered structure contributes to its plastic and high conductivity.

What is the benefit of using OIPC in commercial context?

Electrons can move faster in OIPC as the structure. OIPC contributes to less recharge time and higher conductivity, therefore, higher productivity.

What are some of the key differences between OIPC and ionic liquid electrolyte? Try to explain it with Coulomb's Law.

OIPC is composed of both cations and anions as in ionic liquid electrolyte. However, those ions are delocalized, and the charges are spread out. The distance of separation r increases, and the electric force decreases, therefore it is weak.

What contribute to the pliable characteristics of OIPC?

The weak electric force between charges, and less attraction.

How electrochemical stability in OIPC reflect on industry use?

They have higher energy density, so it will be lighter and longer lasting properties.

Why is it important to have slip-lane property as in OIPC for commercial use?

Closer contact with electrodes, hence better conduction.

Explain graphite and hard carbon properties by using fundamental chemistry.

Graphite has weak London Dispersion Forces between layers. In each extensive layer, carbon bonds to three other carbons, leaving an extra electron that moves freely.

Hard carbon has the falling card, like a deck of cards fallen randomly to each other. It allows bigger space for Na+ to intercalate with. Whereas in graphite, space between layers are not big enough for Na+ to intercalate. Therefore, hard carbon has a better performance in anode material.