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Toyota Announces 4-layer All-solid-state Battery

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Toyota Motor Corp unveiled a prototype of its all-solid-state battery Nov 18, 2010, in Japan. It is a laminated cell measuring about 10 x 10cm.

The exhibited all-solid-state battery. The rectangular cells (top) are lithium-ion rechargeable batteries using organic electrolytes and mounted in Toyota's "Prius Plug-in Hybrid." [Click to enlarge image]

Four sets of positive electrode layers, solid electrolyte layers and negative electrode layers are laminated, and the average voltage of the cell is 14.4V (3.6V x 4). Because Toyota exhibited the cell right after it was charged, it output a voltage of 16.26V (4.065V per layer).

The positive electrode, negative electrode and solid electrolyte of the prototyped cell are made by using lithium cobalt dioxide ($LiCoO_2$), graphite and sulfide, respectively.

By laminating four layers, the voltage of 16.26V per cell was realized. [Click to enlarge image]

Toyota is actively engaged in the development of all-solid-state batteries and lithium-air batteries as next-generation batteries. Especially, when an all-solid-state battery is in an ideal state, its lithium spreads faster than electrolyte, making it theoretically possible to realize a high output power.

Furthermore, all-solid-state batteries are safer than organic electrolytes, which burn at high temperatures. And because they do not contain a liquid material, their packages can be simple.

Toyota confirmed that the prototyped all-solid-state battery can be used at a temperature of 100° C. At this temperature, existing lithium-ion rechargeable batteries using electrolytes cannot be used because their electrolytes boil.

All-solid-state batteries have a problem that a material is produced in a chemical reaction between the boundary surfaces of positive electrodes and solid electrolyte, increasing resistance. To solve this problem, Toyota reduced the resistance of the boundary surfaces by 99% by coating the surfaces of positive electrode materials with ceramics with help from the National Institute of Materials Science (NIMS).

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