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Mass Production of Graphene Composites as Next-Generation Capacitor Materials for Automobiles

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Capacitors (commercially available capacitors are electric double-layer capacitors (EDLC)) are well known as power storage devices that can be charged/discharged in a short time and have an excellent service life, but since the energy density is one order of magnitude smaller than lithium-ion batteries (LIB), it is still a challenge to meet the requirements for energy storage in automotive devices.

In promoting the electrification of vehicles, the development of energy storage devices is an unavoidable theme. Currently, lithium-ion batteries (LIB) are mainly adopted, and research and development of further high energy density is actively being carried out to increase the cruising range. LIB is the highest energy density among existing batteries and is ideal for extending cruising range, but it is difficult to say that it meets market requirements due to the disadvantages of charging and deterioration due to discharge at large currents and short life.

We have been developing graphene-based materials as the next-generation electrode material used in both LIB and EDLC. Graphene is a new carbon material that British researchers won the Nobel Prize in 2010. It is the smallest component unit of graphite (peeled off to one atomic layer) and has excellent physical properties such as conductivity and specific surface area.

We have independently developed graphene/carbon nanotube composite materials (G/CNT materials) that can prevent restacking (a disadvantage of graphene structure trying to return to the original graphite structure) by combining graphene and carbon nanotubes to exhibit their excellent properties (1-3). This material is also expected as a structural material and conductive additive for LIB from the viewpoint of structural stability and conductivity. Since it has a high specific surface area and can store a large number of electrolyte ions, it is attracting particular attentions as a new material to replace activated carbon (which is the electrode material in contemporary capacitors).

In this presentation, we report the development of G/CNT composites as electrode materials for automotive capacitors.
Specifically
(1) Basic process development;
(2) Mass production technology;
(3) Immediate development goals such as performance and cost considerations.

Compared to activated carbon as the active material used in existing supercapacitors as show in Fig1., this new graphene composite material can store more ions and has higher specific power and higher energy density because of its large specific surface area and high crystallinity. In this presentation, we will describe the research and development of the basic technologies for mass production of this graphene composite material, which is targeted for application as a next-generation rapid chargeable energy storage material for automobiles.

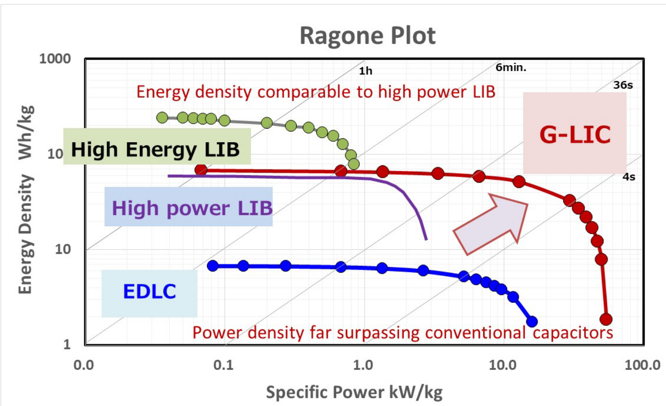

Fig.1 Ragone Plot of Graphene Lithium Ion Capacitor(G-LIC)

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