Challenge the Limit of LIB and Beyond by Advanced Materials Design

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As the development and market growth of electric vehicles progresses faster than expected and he functions of mobile devices are being strengthened, performance enhancement of energy storage technologies is becoming more important. Lithium-ion batteries (LIB), the optimal energy storage devices to meet these needs, continued to improve performance through material innovation in the concept of electrochemical devices.

However, performance advances in energy storage materials based on Li intercalation chemistry have slowed down on the learning curve, making it difficult to further improve without the discovery of new materials or new designs. And the development and commercialization of new chemistry still needs more time to be completed to meet the criteria of the market.

Now, it is thought that this is time for new challenges for material scientists and electrochemists in these technical and industrial environments. In other words, we must challenge the practical limitations of LiB based on proven principles. At the same time, it is necessary to propose and implement a new chemistry design that can overcome the performance limitations of LIB. In fact, these research activities are already underway at many academia and research institutes. Material design is underway through calculation based on advances in computing power, and deep-down analysis of unsolved phenomena has become possible with advances in analytical technology. Based on this, advanced material design is proceeding differently from the previous one.

Utilizing these advanced methodologies, in this presentation, we will introduce the R & D activities to challenge the ultimate of LIB being carried out at Samsung SDI, and introduce development contents for next-generation battery innovation.

With regard to ultimate LIB, we will report high-Ni metal oxide materials capable of stable intercalation, Si/carbon composite materials capable of alloying/de-alloying, and high performance electrolyte additives to support these novel active material reactions. As for beyond LIB, researches on novel ion storage materials (Na, Mg, S and Li) and ion transfer materials (polymers, ceramic electrolytes) are actively under way. In addition, to strengthen price competitiveness, concepts and experimental results of Co-less or free cathode materials will be discussed, which will avoid the effects of fluctuations in raw material prices.

With this future prospective, technical concepts and recent achievements listed above, it is proposed to challenge the limit of LIB and beyond.