From Information Technology to Energy Technology

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Over 3 decades in the Heisei era, the devices that surrounded us underwent major changes. Technology transformed completely from analog to digital in all walks of life. For example: from vacuum tubes to IC, and LSI; from CRTs to liquid crystals, and organic ELs, from fixed-line phones to mobile phones, and smartphones; from records to CDs, and iPads; from VHS to DVDs, and Blu-ray disks; from calculators to EXCEL and so-on. The performances of such physical digital devices have made exponential progress following Moore's Law. Furthermore, not only have technologies advanced rapidly but also these spread speeds have accelerated. It took half a century for fixed-line phones to become commonplace, 12 years for mobile phones to proliferate, and only 7 years for the Internet to become ubiquitous.

On the other hand, devices driven by chemical reactions cannot so easily improve performances through digitization from atoms to bits. The improvement in the performances of typical nickel-cadmium and nickel metal-hydride batteries had not kept pace with the weight reduction and downsizing of portable physical digital devices. The rechargeable battery was actually a bottleneck in the spread of Personal Digital Assistants. However, since the 90's, the commercialization of lithium-ion batteries in the early Heisei era has enabled the rapid growth of the cellular phone industry. And now in the Reiwa era, a high-throughput, 5G wireless network society is coming; its drastic impact will be felt in all spheres of our society.

In addition, the main target of the rechargeable batteries are expanding from telecommunications to the transportations and ancillary services sectors. As a consequence, the priority of batteries is shifting from higher energy density to higher cost-performance. To satisfy such future needs, many new research trends in post-lithium ion battery research are taking shape, as can see in this special issue: from rare metals to rare metals-free; from non-aqueous systems to highly concentrated aqueous solution systems; from liquid systems to all-solid-state battery systems; from oxide systems to sulfides, fluoride and hydrid systems; from insertion reaction chemistry to conversion reaction chemistry. Actually, it is not easy to predict what kind of electrochemical energy device will take the leading role in the future society from now on. However, there is no doubt that energy devices such as rechargeable batteries, capacitors, and fuel cells will play an increasingly important role in the Reiwa era. I hope that this special issues will give you strong inspiration for future energy devices.

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