Functionality Controls of Metallic and Graphene Oxides Based on Solid-State-Nanoionics

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The microfabrication size for the conventional semiconductor devices will reach the atomic scale in near future. It is evident that not only the limits to conventional fine processing technology but also the physical operating limits of semiconductor devices are being reached. One possible way to overcome these technological and physical limits of the existing conventional semiconductor devices is to achieve breakthroughs in novel device materials and novel device-operation principle using nanotechnology. A promising type of such nanodevices is the solid-state-nanoionics device, which is operated by controlling the local ion migration and electrochemical reaction in solids. The ionics has been known to be a field in which the local ion transport and electrochemical phenomena are treated and, up to now, it has been different to electronics, which treats the transport phenomenon of the electron and the hole.

We have found interesting properties and functions, such as analogue memory property, programming rectification, quantized conductance atomic switch, and nonvolatile resistance switching, in nanoionics devices with simple layer structures [1-9]. These properties and functions are realized by local ion migration in a nanoscale electrolyte layer of electronic-ionic mixed conductors or pure ionic conductors.

In this presentation, we will introduce ways to control the local ion migration and electrochemical reaction using the ionic conductor. Furthermore, the unique phenomena and function caused by these nanoionic controlling in order to fabricate novel nanodevices based on stacked layers, such as metallic oxide or graphene oxide/ionic conductor [7-9] are demonstrated.

References

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