Special Feature: Analysis Techniques to Evaluate the Next Generation Electronic Materials

Overview

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Urgent developments are needed in motors and inverters in anticipation of electrification of electric vehicles and hybrid vehicles. The next-generation electronic materials used in inverters have more advanced requirements in terms of their characteristics and features than materials of the past, and advancements in analytical technologies to evaluate these materials are also required. Thus, there is a demand for high-quality analytical techniques for morphological observation, crystal defect analysis, and structural analysis utilizing electron beams, X-rays, and synchrotron radiation.

We introduce five examples of electronic material analysis making full use of our technological prowess. In the first article, we introduce luminescence analysis techniques for crystalline defects in semiconductor devices. Second, a unique interface analysis technique is presented in SiC metal oxide semiconductor field effect transistors, which are nearing practical use. The method enables analysis of local atomic structures such as vacancy defects and lattice distortions, using synchrotron radiation. Third, dislocations in a gallium nitride crystal, which is considered to be a next-generation device in addition to silicon carbide, were analyzed using synchrotron radiation X-ray topography and transmission electron microscopy to clarify the formation mechanism of dislocations. Fourth, regarding two-dimensional crystals of silicenes and germaneness, which are expected to be next-generation devices that overtake both silicon carbide and gallium nitride, we introduce the process of their structural determination using transmission electron microscopy. Finally, we present reliability analysis methods for power modules and structures based on non-destructive internal degradation measurement using synchrotron radiation.