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Quantitative characterization of the crystallinity of polycrystalline materials by applying electron back-scatter diffraction

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Recently, physical properties of polycrystalline materials have been found to vary drastically depending on their micro texture. The crystallinity of grain boundaries was found to dominate both their mechanical and electrical properties and long-term reliability. This is because various defects such as vacancies, impurities, dislocations and local strain easily concentrate around grain boundaries and thus, degrade the quality of atomic configuration in grains and grain boundaries. In this talk, a grain boundary is defined as volumetric transition area between two grains, though it has been defined as a line interface between nearby grains. The quality of grain boundaries is independent of crystallographic orientation of nearby grains. Crystallinity of grain boundaries can be evaluated quantitatively by applying Electron Back-Scatter Diffraction (EBSD) method. The order of atom arrangement in the observed area is analyzed by the sharpness of Kikuchi lines obtained from the observed area. Various materials properties vary drastically depending on the order of atomic alignment, in particular, in grain boundaries. Both fluctuation and degradation of various properties of materials such as heat-resistant alloys and thin films are investigated from the viewpoint of the crystallinity of grains and grain boundaries. In addition, the diffusion of component elements is dominated by the local quality of grain boundaries. The degradation of materials mainly starts to occur around grain boundaries with low crystallinity because atomic diffusion is accelerated drastically along the poor-quality grain boundaries. Therefore, it is very important to evaluate the crystallinity of advanced materials or assuring their safe and reliable operation.

Biography

Hideo Miura has completed his PhD from Tohoku University, Japan. He had worked as a Chief Researcher and is the Director and Professor of Fracture and Reliability Research Institute. His main research topic is prediction and prevention of fracture of advanced functional materials and thin-film devices. He has published more than 200 technical papers in the field of mechanical reliability of various materials and thin-film devices and obtained more than 200 patents all over the world.

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