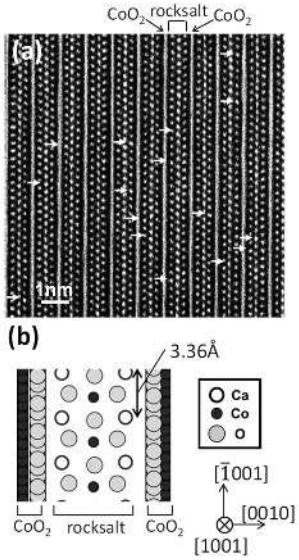
Name	Job Title	Area of Expertise
MORIMURA Takao	Professor	Crystal Structure Analysis

1. Main Research Topics

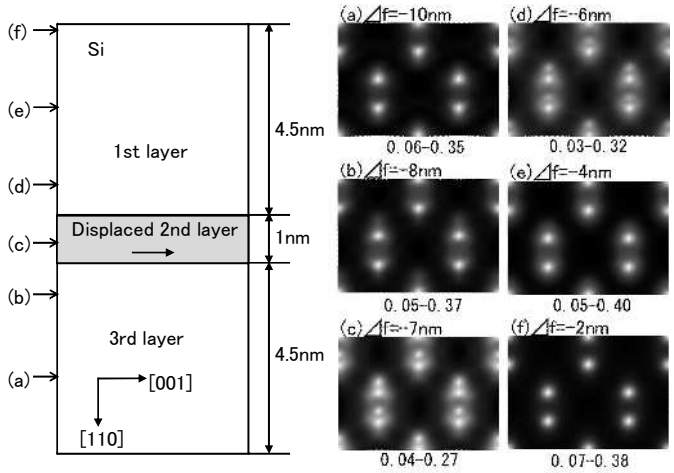
① Development and Structural Analysis of Thermoelectric Materials

We fabricate thermoelectric materials using methods such as spin-casting liquid quenching, sintering, and vapor deposition. We develop high-performance thermoelectric materials by combining physical property measurements, such as the Seebeck coefficient, electrical conductivity, and dimensionless figure of merit, with structural analysis using scanning transmission electron microscopy (STEM). The figure on the right shows an experimental STEM image of the Sr-doped misfit-type layered oxide $Ca_3Co_4O_9$ (a) and a projection from the [110] direction (b). In (a), Ca and Co atoms are observed as bright spots. Sites occupied by heavier Sr atoms are observed as brighter spots, as indicated by the arrows. This suggests that the added Sr is substituted and distributed within the misfit-type layered oxide $Ca_3Co_4O_9$, contributing to improved thermoelectric properties.



② Development of a Simulation Method for Scanning Transmission Electron Microscopy image

Quantitative analysis of STEM images requires solving the Schrödinger equation and simulating the images. In this research, we are developing a new STEM image simulation method by applying the Bloch wave method, which is advantageous for periodic structures, to crystals containing defects. The figures show schematic Si with the second layer slightly displaced in the [100] direction (left) and a simulated image (right) when an electron beam is incident from the [110] direction. By changing the objective lens focus Δf, images can be obtained near the depths indicated by the arrows, suggesting that 3D structural analysis is possible.



2. Keywords

thermoelectric material, Scanning transmission electron microscopy, Electron diffraction theory, Bloch wave method

3. Remarks and Websites

We are conducting research that lead to the development of high-performance materials through atomic-level structural analysis. Our goal is to clarify the mechanism behind the high thermoelectric properties. We are also conducting collaborative research on SiC defect structural analysis through Center for Advanced Microdevice Research in the Interest of Society (CAMRIS) in Nagasaki University.

researchmap: https://researchmap.jp/read0172791/
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/kessho/