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Overcoming the limitations of scanning electron microscopy with AI

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Source: Pohang University of Science & Technology (POSTECH)

Summary: A team develops a highly efficient super-resolution imaging based on deep learning.

FULL STORY

What if a super-resolution imaging technique used in the latest 8K premium TVs is applied to scanning electron microscopy, essential equipment for materials research?

A joint research team from POSTECH and the Korea Institute of Materials Science (KIMS) applied deep learning to the scanning electron microscopy (SEM) to develop a super-resolution imaging technique that can convert a low-resolution electron backscattering diffraction (EBSD) microstructure images obtained from conventional analysis equipment into super-resolution images. The findings from this study were recently published in the *npj Computational Materials*.

In modern-day materials research, SEM images play a crucial role in developing new materials, from microstructure visualization and characterization, and in numerical material behavior analysis. However, acquiring high-quality microstructure image data may be exhaustive or highly time-consuming due to the hardware limitations of the SEM. This may affect the accuracy of subsequent material analysis, and therefore, it is paramount to overcome the technical limitations of the equipment.

To this, the joint research team developed a faster and more accurate microstructure imaging technique using deep learning. In particular, by using a convolutional neural network, the resolution of the existing microstructure image was enhanced by 4 times, 8 times, and 16 times, which reduces the imaging time up to 256 times compared to the conventional SEM system.

In addition, super-resolution imaging verified that the morphological details of the microstructure can be restored with high accuracy through microstructure characterization and finite element analysis.

"Through the EBSD technique developed in this study, we anticipate the time it takes to develop new materials will be drastically reduced," explained Professor Hyoung Seop Kim of POSTECH who led the research.

This research was conducted with the support from the Mid-career Researcher Program of the National Research Foundation of Korea, the AI Graduate School Program of the Institute for Information & Communications Technology Promotion (IITP), and Phase 4 of the Brain Korea 21 Program of the Ministry of Education, and with the support from the Korea Materials Research Institute.

Story Source:

Materials provided by **Pohang University of Science & Technology (POSTECH)**. *Note: Content may be edited for style and length.*

Journal Reference:

1. Jaimyun Jung, Juwon Na, Hyung Keun Park, Jeong Min Park, Gyuwon Kim, Seungchul Lee, Hyoung Seop Kim. **Super-resolving material microstructure image via deep learning for microstructure characterization and mechanical behavior analysis**. *npj Computational Materials*, 2021; 7 (1) DOI: 10.1038/s41524-021-00568-8

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