Clearer and better focused SEM images

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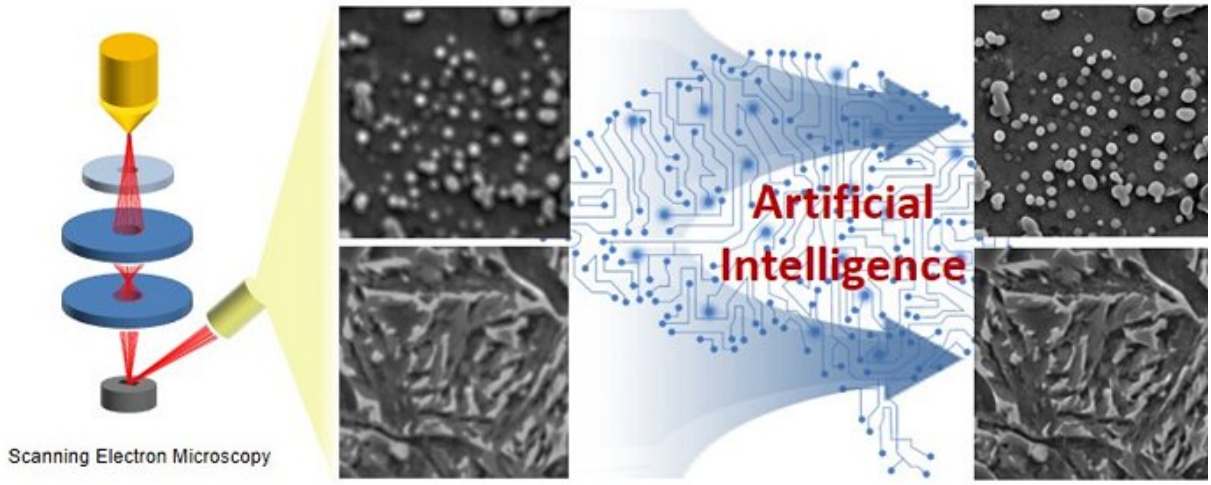

Credit: Pohang University of Science & Technology (POSTECH)

With the onset of the 4th industrial revolution, artificial intelligence has recently been utilized in smartphone cameras, providing functions such as auto-focusing, face recognition, and 100x zoom, to dramatically improve our daily life. It has also been applied to research and development of new materials.

A joint research team from POSTECH and Korea Institute of Materials Science (KIMS) has applied deep learning to the scanning electron microscopy (SEM) system to develop a technique that can detect and

improve the quality of SEM images without human oversight. The EMS is an essential material analysis equipment used for developing new materials. The findings from this research were recently published in *Acta Materialia*, the most authoritative journal in the field of metal materials.

The SEM is one of the most advanced types of material analysis equipment crucial to investigating the correlation between the microstructural and physical, chemical, and mechanical properties of materials by providing their microstructural image data. However, in order to obtain high-quality, clear SEM images, the operator must be highly-skilled to maneuver the system with high precision—otherwise, it can lead to low-quality microscopy images. The quality of these images needs to be improved because they directly affect the subsequent material analysis processes.

To this, the joint research team developed a deep learning-based refocusing method that automatically detects and improves the quality of the microscopy images. This technology is based on a multi-scale deep neural network and it demonstrated that the image quality can be improved on blind settings without any prior knowledge or assumptions of the degree of blurring on the level of image degradation. In addition, the researchers also proposed a technique to train the network to learn not only how but also where to refocus in non-uniformly defocused images, moving a step closer to commercializing AI-based material analysis equipment.

"We expect the cost and time for developing new materials to be reduced by automating the SEM imaging process of the scanning electron microscopy, which is widely used for research and development of new materials," remarked Professor Seungchul Lee who led the study.

More information: Juwon Na et al, Deep learning-based

discriminative refocusing of scanning electron microscopy images for materials science, *Acta Materialia* (2021). DOI: 10.1016/j.actamat.2021.116987

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