Automation of Scanning Probe Microscopy Using AI Technology

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Abstract

Scanning Probe Microscopy (SPM) is an essential tool for studying the surface structure and properties of materials at the nanoscale. Traditionally, operating SPM requires a high level of expertise and consumes significant time in analysing large volumes of data. Consequently, AI technology is being applied to enhance and analyse images obtained through SPM [1]. Against this backdrop, this research introduces the automation of data collection and analysis processes in SPM using Artificial Intelligence (AI) technologies. Specifically, using object detection technology developed with Python and YOLOv5, this study automates the counting of specific objects within SPM scan images and enables zoomed-in scanning of these objects by developing a modular type software. This software has been applied to the controller of an open-source Atomic Force Microscope [2]. It automatically identifies objects of interest, counts them, and adjusts the scanning range of SPM for detailed analysis based on the user's selection of objects. This significantly simplifies the operation of SPM and improves the efficiency and speed of research and analysis of nanoscale materials, while also reducing the time researchers spend on processing and analysing nanoscale images. This study is anticipated to improve the accessibility and usability of nanoscale research.

References

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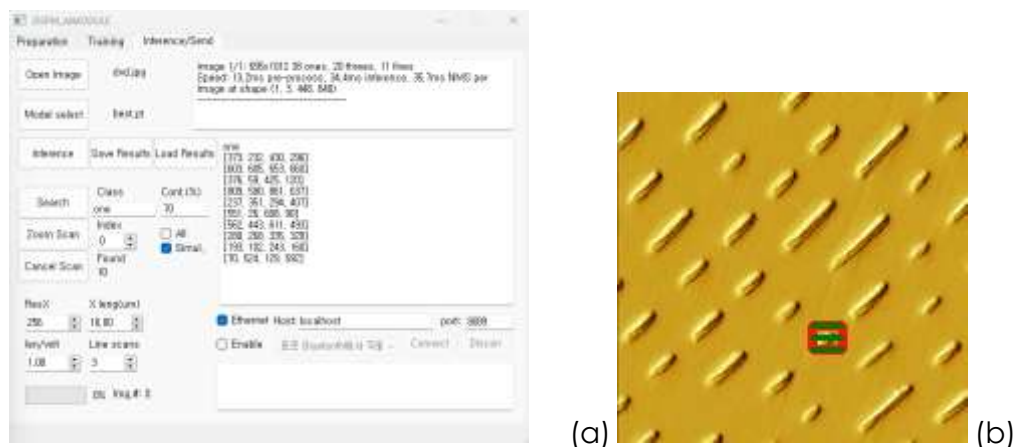
Figures

Figure 1: (a) Developed AI module software, (b) result of object detection [3].