Giving a microscope the intelligence to see and manipulate: automated information extraction for single atom control

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Experiments within the last few years have shown promise for utilizing the focused electron probe of a scanning transmission electron microscope (STEM) for moving single atoms within a crystal lattice and assembling tailored structures in this way.[1-7] These demonstrations involve manually positioning the electron beam at specific lattice sites at various beam energies to induce a material transformation at the atomic scale. However, for such techniques to become routine material fabrication technologies, new tools must be developed to automate various microscope operations like drift compensation, noise reduction, atom identification, defect characterization, and beam positioning.

In this talk, the current state of progress will be briefly reviewed and a variety of tools under development will be discussed with particular focus on the role of deep learning for extracting meaningful information from a data stream in real time.[8-10]

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