A SCANNING TRANSMISSION ELECTRON MICROSCOPE (STEM) fires a beam of electrons through a sample of material to pinpoint atoms and reveal the material’s crystal structure. For imaging, the downside is that the beam can move atoms slightly. But if these modifications can be controlled, it could be a boon. New materials could be built atom by atom by controlling the electron beam precisely. Such bespoke materials might enable new classes of devices for quantum computing, spin sensing and more.

THE ATOMIC FORGE

PRECISE BEAM
A beam delivers a prescribed dose of electrons to a particular site in a crystal for a certain length of time to move an atom as desired.

BEAM CONTROL
Open-source software gives researchers full control over the precision, velocity and power of the electron beam.

FAST DETECTOR
Information about the sample’s atomic structure is gathered in real time by detectors with many pixels.

FEEDBACK SYSTEM
A powerful computer analyses the detector data in real time and decides how to control the beam to make the next atomic move.

NEW MATERIALS
By testing new atomic architectures, researchers will be able to design materials with specific properties and learn more about interactions between the beam and sample.