STEHM Highlights

The best resolution microscope ever built

The Scanning Transmission Electron Holography Microscope (STEHM) will be the best high-spatial resolution microscope ever constructed and it will maintain its high position at the forefront of this rapidly moving competitive technology for many years. The STEHM will build upon the fundamentals of a standard electron microscope, which uses electrons rather than light, The Cs + Cc correctors improve the spatial resolution to picometers, substantially better than angstroms, which is the recent state-of-the art. The Cs corrector localizes the information in lattice images so the contrast of a lattice position in the image has a one-to-one correspondence with an atomic position, whereas without these correctors this is not possible. A Cs + Cc corrector reduces the point spread function to the dimensions of the electron probe enabling the sampling of the specimen at sub-atomic dimensions. Both aberration correctors will make it possible to see atomic columns that don’t have to be interpreted and previously hidden positions of atoms, and, when used by electron holography, measure the electron density between the atoms.

Multiple electron biprisms substantially improve the spatial resolution of holograms by separating the contrast of the fringes from the interference width of the holograms. The use of three biprisms placed below the specimen permits flexible control of all of the interference parameters, ie., the interference region, fringe spacing and fringe angle, involved in electron holography [2]. Scanning-beam electron holography is made possible by placing an additional biprism above the specimen. Multiple biprisms enable many forms of electron holography to be possible, as envisioned by Cowley [3]. For example, holography typically reconstructs its holograms outside of the microscope using Fourier transform methods. Two electron biprisms enable the hologram to be reconstructed inside the microscope so a phase image of the specimen can be directly observed during the experiment. Multiple electron biprisms also enable the creation of confocal electron holography, which will be used to make three-dimensional measurements of the physical, electrostatic and magnetic properties of a specimen.

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Electron holography is the only means possible to measure the dimension of the electrostatic field between the source and drain of field emission transistors.

Similarly, high-resolution electron holography should be able to measure the orientation of the spinning electron’s magnetic field to characterize spintronic devices.

Other unique capabilities include the measurement of the composition and defect density of self-assembled nanodots for nanotechnology, the domain structures of magnetic materials, which when combined with the Cs + Cc correctors may be able to measure the dimension and properties of the dom9.5(a),eruremiad dhe edomp.3(u)4.3(n of(e)4ts,6(i)-5.3(h4-.9(e)9.3(h8-6(e)4.2(domis.2(dor