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Nanoscale diffraction gratings and electron vortex beams in a scanning electron microscope ALEXANDER SCHACHTNER, CARLY WRIGHT, BENJAMIN MCMORRAN, TYLER HARVEY, TYLER YAHN, JORDAN PIERCE, University of Oregon dept. of Physics — We use focused ion beam nanofabrication to manufacture forked diffraction gratings capable of producing electron beams with helical wavefronts and orbital angular momentum (OAM). A vast number of unique beam modes carrying OAM can be produced through manipulation of grating fork number or position. Generally these gratings are milled such that they produce a phase shift in the beam and are used with high energy electrons (300keV) in a TEM to investigate the quantum or magnetic properties of the electron or image magnetic materials. Our latest work focuses on manufacturing sub-100-nm pitch binary transmission gratings that produce only an amplitude modulation, which opens up imaging capability to lower energy electrons (5-30 keV) and thus expands their use to a wider range of commercially available SEMs. We use these amplitude gratings to show the relationship between the number/position of forks and OAM inherited by the beam. This work could lead to advances in imaging capability, and also creates a widely accessible and scalable demonstration of the quantum properties of the electron which can be leveraged by any science program with SEM access.

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