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Interference of electron diffracted beams from crystals and amorphous materials to measure their structure, mean inner potential and coherence properties[1]

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This talk presents electron interferograms of crystals and amorphous materials used to measure their structure, mean inner potential and the coherence properties of their quasiparticles such as phonons, plasmons and, hopefully in the future, magnons. Recent methods of k-space interference has revealed that practically all electron intensities on the diffraction plane of a modern TEM have sufficient coherence to produce interferograms when self-interfered under a wide range of diffraction conditions. These diffraction intensities are of interest because they represent the material's atomic structure, which for amorphous materials has not yet been solved because of their complexity and missing phase information. For amorphous materials, two new methods of electron interference have been creaated. One is a wavefront-splitting method used for a-C, a-Si, a-Ge, SiO_2, a-W and a-ZrNiFe metal. The other is an amplitude spitting method that interferes a crystal's Bragg diffracted beams that contains intensities of an amorphous thin film on the crystal's surface. The fringes in these interferograms have been produced to high scattering angles necessary to remove dynamic diffraction effects in order to measure the coherence of the quasiparticles. Although relative phase information of materials has been obtained, the absolute phase may be obtainable using a new electron holography microscope having multiple electron biprisms, an imaging energy filter and an excellent coherent source soon to be received by UVic and open for use by everyone. An immediate application of the wavefront-splitting method is as a new method to measure the spatial resolution of the TEM, which occurs at the shear angle for fringe disappearance that is easily controlled using the electron biprism and measured by a Fourier transform showing realization from previous possibilities.

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