Generation of electron vortex beam with high quanta of orbital angular momentum (l=1000) with holograms fabricated by electron beam lithography

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Generation of electron vortex beams (EVBs) is one of the most interesting topic in electron microscopy nowadays. Creating the EVBs carrying large orbital angular momentum will find promising and fundamental applications [1-3]. In this work the largest EVB with OAM (L=1000 ħ) is explained and the high quality of produced vortex beams is quite interesting. This achievement is due to the fabrication of the holograms by electron beam lithography for the first time. This new fabrication method we offer here is a capable and alternative method for dense patterning instead of Focused Ion Beam (FIB) methods. The OAM of the generated beams is demonstrated through the propagation of the EVB after a hard aperture cut [5]: the comparison with simulations confirms that the average OAM = (960±120) ħ, completely compatible with the aimed value. Using EBL offers better fabricated structures for this aim, as: 1) the maximum OAM reached, 2) in the minimum detail reproduced (here reaching 18-33 nm) , 3) in the better uniformity of the frequency response 4) in the better suppression of higher order diffraction due to a nearly perfect rectangular groove profile We therefore believe this will be the fabrication technique for most of the new diffractive optics with electron in the coming future Further, even more complex holograms will be demonstrated as well as some applications in material science.

References

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