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CD-SEM Characterization of Smoothly Varying Wave Structures with a Monte Carlo Simulation

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EXTENDED ABSTRACT: Scanning electron microscopy (SEM) characterization of smoothly varying nanograting structure (Pt-coated Cr grid on Si substrate) in sinusoidal waveform has been carried out by a Monte Carlo (MC) simulation technique. Previous studies on critical dimension (CD) by CD-SEM have been mostly concerned about the line structures having sharp edges so that there is an obvious edge bloom in the linescan profile of secondary electrons. In contrast, the present grating structures prepared by a laser-focused atomic deposition technique have smoothly varying waveforms in cross-sectional profile, which presents a larger difficulty for quantitative structural characterization by SEM. The grating structure, having a fixed pitch of λ/2 as a period of the standing-wave laser light field, where λ is the wavelength of the corresponding laser light, can be used as an ideal nanoscale metrological length tool; therefore, it is important to characterize the structural features over a large deposited area by SEM imaging for quality control towards mass reproduction. The present work extends the CD characterization of the MC simulation methods to more complex structures. Taking into account different experimental factors, i.e., primary electron beam parameters, geometrical parameters, and material properties, the unknown geometrical parameters (i.e., base height, peak height, linewidth shrinkage, and peak tilt angle) of the grating lines have been successfully extracted from the experimental linescan profiles of SEM images.

Keywords: Linescan; Nano characterization; CD-SEM; Monte Carlo Simulation; Atom Lithography

BIOGRAPHY

Muhammad Saadat Shakoor Khan has completed his Bachelor's degree in computational physics from the University of Punjab Lahore, Pakistan. He has completed his Master's degree from the University of Science and Technology of China under the supervision of Prof. Zejun Ding. He is currently engaged in a Ph.D. degree program under the supervision of Prof. Zejun Ding.

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