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Light scattering from defected nano-sized objects on a surface with DDA-SI

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Light scattering can be used for characterization of nanostructures on surfaces, surface impurities and defect detection for nano-manufacturing applications and related industries such as semiconductor industry. In the case of symmetric objects in free space light scattering calculation is relatively easy by using Lorentz-Mie theory but by introducing a surface under the particle or a defect the symmetry is broken and the problem becomes more challenging and computationally demanding. We used discrete dipole approximation with surface interaction (DDA-SI) for carrying out the analysis. DDA-SI is on the basis of discrete dipole approximation but the interaction matrix is modified for the presence of the surface by addition of the dipole reflection terms, calculated with the Sommerfeld integral formulation. Light scattering from structures of arbitrary cross section and the size of the order of a wavelength can be quickly determined by this method. Light scattering from dielectric nano-rod structures on a surface by an evanescent decaying wave or a plane wave is calculated with DDA-SI package. The effects of different type of defects on the far-field scattering investigated to show the effects of a small amount of missing material can be detected e.g. when integrated-circuit structures are inspected for defects. DDA-SI package was improved for its computation efficiency. A comparison between the performance of original and improved version of DDA-SI is carried out.

Keywords: discrete dipole approximation, surface interaction, far field, scattering, defect detection