The qualitative phase retrieval by the combination of TIE and SCWP with sub 100 nanometer resolution

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In x-ray imaging, the phase contrast is generally 100 to 1000 times higher than the absorption contrast in soft material. However, the quantitative phase information is required for the phase tomography in order to fully utilize the capability of the x-ray imaging. In this work, we demonstrate that the quantitative phase retrieval with a sub-100nm resolution can be achieved from micrographs of zone plate based transmission x-ray microscope (TXM)[1,2]. In this work, a zone plate made of plastic containing objects of sizes from m down to tens of nano-meter is used as a test sample to quantify the retrieved phase. Using the focal serial images in the image plane, the phase information is retrieved quantitatively across the entire range of sizes by combining the transport intensity equation (TIE)[3] and self-consistent wave propagation methods (SCWP)[4] in this partial coherence system. The results show a good agreement with simulation. The study demonstrates a solution to retrieve the phase in the TXM and overcome the deficiency encountered in the two phase retrieval approaches of TIE and SCWP.

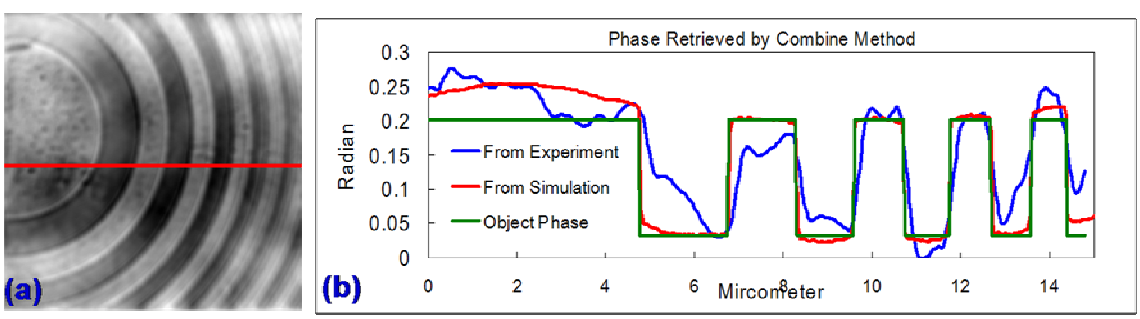

Fig1. The result phase retrieved from the plastic zone plate. (a) the phase image of zone plate. (b) the cross section plot of red line in (a).

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