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Modeling Surface Plasmon Enhanced Contact Lithography

MATTHEW ARNOLD, RICHARD BLAIKIE, MacDiarmid Institute for Advanced Materials and Nanotechnology, Electrical and Computer Engineering, University of Canterbury, New Zealand — Surface Plasmon Enhanced Contact Lithography (SPECL) is a technique for improving sub-wavelength image quality by placing a noble metal beneath the imaging layer in the near-field of a mask. Previous computational[1,2] and experimental[3] studies suggest that that SPECL can improve process latitude compared to pure contact techniques, but future investigations will benefit from a better understanding of the underlying mechanism. We present some numerical simulations, and interpret the results in terms of balanced interference of the “sources” consisting of the mask at the top and coupled plasmons at the bottom. Reflected evanescent fields are amplified by a factor that increases with the lateral propagation constant, and hence the usual “phase” decay is partially compensated. The observation of an optimal coupling distance is consistent with the inverse relationship between coupling distance and plasmon amplitude compared to the mask fields. Finally we present some data relevant to future experimental exploration. [1] R.J. Blaikie, and S. J. McNab, Assoc. of Asia Pacific Physical Societies Bull. **11**(3), 15 (2002). [2] D.B. Shao, and S.C. Chen, Opt. Express **13**, 6964 (2005). [3] D.B. Shao, and S.C. Chen, Appl. Phys. Lett. **86**, 253107 (2005).

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