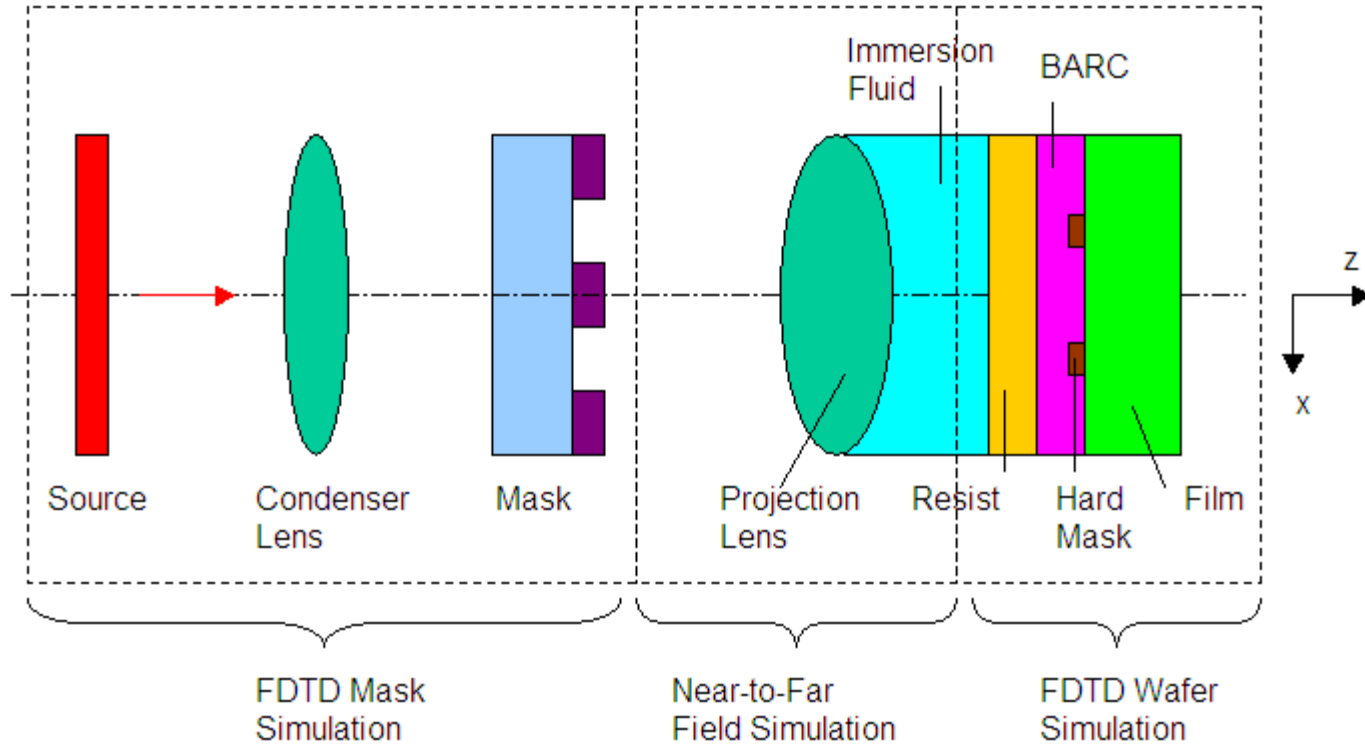


Simulation of Wafer Topography Effects in Double Patterning Lithography

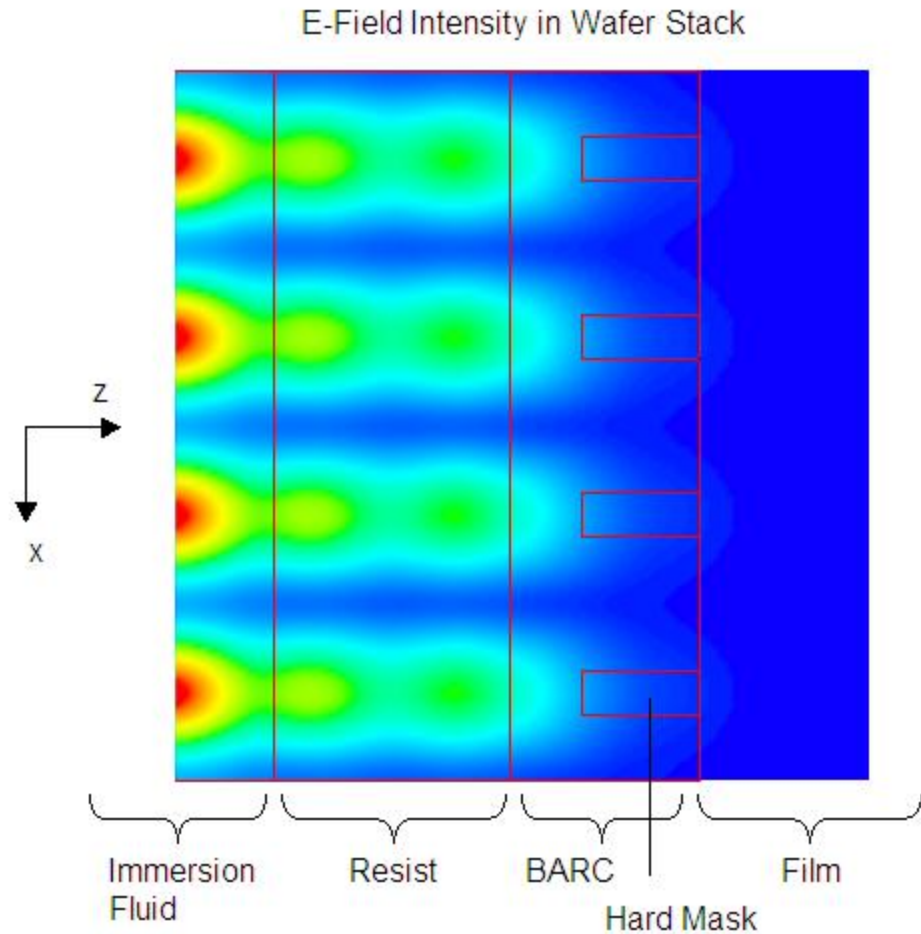
Simulation Setup

This example simulates the non-planar wafer effects in the 2nd exposure in double patterning lithography. The non-planar film stack is created as a result of hard mask pattern formed by the 1st exposure and etch. In addition to the rigorous wafer exposure simulation, the 3D thick mask scattering effects and non-Hopkins oblique incidence effects are also rigorously simulated in this example.



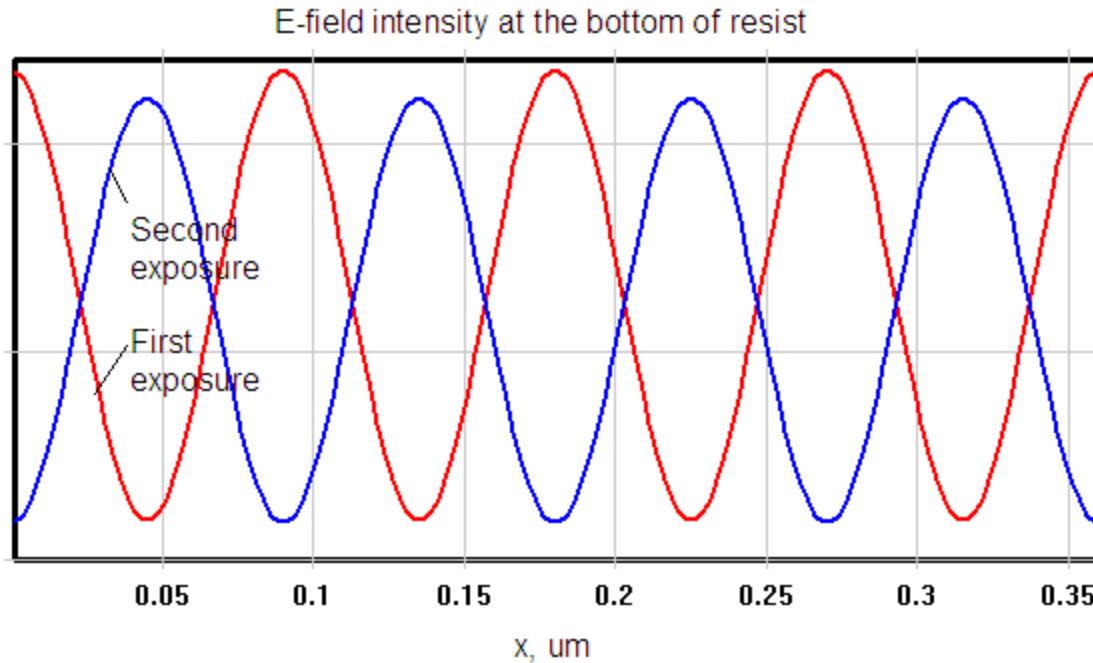
As shown in the above figure, the mask transmitted near field is first computed using the FDTD solver of EM Explorer. The mask near field is then propagated through the projection lens to the far field at the wafer. Lastly, the far field is used as the incident field for the FDTD simulation of non-planar wafer exposure. The entire simulation is run using a single EM Explorer input file.

E-Field Intensity in Wafer Stack



The left figure shows the e-field intensity distribution in the wafer stack as well as in the immersion fluid. Note the bottom anti-reflection coating (BARC) has not been optimized in this example, so the standing wave pattern in the resist is visible.

E-Field Intensity in Wafer Stack



The e-field intensity sliced at the bottom of the resist is shown in the above figure. The intensity of the first exposure is also shown as comparison. The first exposure result was obtained from a separate simulation where the mask pattern was shift by 1/2 pitch and the same wafer stack was used except that the hard mask layer was planar. The non-planar effects in the 2nd exposure is evident compared to the 1st exposure.