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DYNAMIC SIMULATION OF DISCHARGE AND LASER PRODUCED PLASMA FOR EUV LITHOGRAPHY DEVICES*

A. Hassanein[1], V. Sizyuk[1], V. Morozov[1], I. Konkashbaev[1], T. Sizyuk1, B. Rice[2], V. Bakshi[3]
[1]Argonne National Laboratory, Argonne, IL 60439,USA
[2]Intel Corporation, Component Research Division, Hillsboro, OR 97124, USA
[3] SEMATECH, Austin, TX 78741, USA

Both laser and discharge produced plasma such as z-pinch devices are being used as a light source for EUV lithography. A key challenge for Discharge Produced Plasma (DPP) devices is achieving sufficient brightness to support the throughput requirements of High-Volume Manufacturing (HVM) lithography exposure tools. An integrated model for the description of hydrodynamics and optical processes in a DPP device has been developed and integrated into the HEIGHTS–EUV computer simulation package. Model development consisted of three main tasks: plasma evolution and MHD processes; detailed photon radiation transport, and physics of plasma/electrode interactions in DPP devices. Plasma flows have multidimensional character in pinch systems. Advanced numerical methods for the description of magnetic compression and diffusion in a cylindrical geometry are used in the HEIGHTS package. Radiation transport of both continuum and lines is taken into account with detailed spectral profiles in the EUV region. Radiation transport is solved using two different methods. Discharges using Xenon and Tin gasses are simulated and compared. Benchmarking of EUV signals and plasma parameters in both laser and z-pinch devices is presented.

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THE OPTIMIZATION OF WORKING GAS COMPOSITION FOR HIGH-EFFICIENCY PDP DISCHARGES*

H. J. Lee, D.-K. Lee, J.-H. Choi, Y.-S. Cho, H.-J. Lee, and C.-H. Park
Electrical Engineering Dept., Pusan National University, Pusan 609-735, South Korea

A plasma display panel (PDP) is one of the best candidates for a large-scale flat panel display using plasma technology for high definition TV. The gas mixture ratio of PDP discharge plays a very important role in several issues in AC PDP researches such as lowering operating voltage for cost reduction, increasing voltage margin for stable operation, and enhancing brightness and luminous efficiency for good image quality. In this study, experimental measurements are reported for firing and sustain voltages, voltage margin, luminance, and luminous efficiency with the change of the mixture ratio of Ne-Xe-He noble gases. In a Ne-Xe binary gas mixture, the increase of Xe contents results in the increases of luminance and luminous efficiency while it also results in the increase of the breakdown voltage and the discharge time lag. With the inclusion of He gas, the discharge time lag decreases, but the luminance and the luminance efficiency changes differently for high Xe and low Xe cases. With a low gas mixture ratio of Xe (less than 8%), the luminance efficiency increases with the amount of He gas at the same total pressure. With a high Xe partial pressure (more than 10%), however, there is an optimal value for He contents above which the luminance efficiency decreases as He partial pressure increases. From the experimental results, it was observed that a Ne:He mixture ratio of 9:1 yields the most efficient discharge characteristics for a standard AC PDP cell with Xe gas fraction of 10~30% at the total pressure of 400~500 Torr. The experimental results are also compared well with those of a two-dimensional fluid simulation. A discharge road map is generated from the experimental and simulation results in order to explain the behaviors of firing and sustain voltages, discharge time lag, luminance, power loss, and luminance efficiency. Furthermore, experimental results are reported for the effect of other gases, such as Kr, Ar, and H_2, on luminance efficiency.

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