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Key issues in the design of innovative RF plasma sources

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Recently the demand for the semiconductor has been increasing due to wide spread of portable devices as well as computers. Radio frequency (RF) Plasma devices play a major role in the semiconductor processes such as etching and plasma enhanced chemical vapor deposition (PECVD), and the use of plasma is desired even in atomic layer deposition technology. In spite of wide use of plasma in the industry, a number of difficulties have been arising in designing plasma devices. In this presentation, several issues in designing RF plasma sources are discussed. For capacitive coupled plasmas (CCP), the target electron energy distribution should be considered first since it determines the the process chemistry. The effects of electrode gap distance, pressure and driving frequency in electron energy distribution are presented. Standing wave effect, which arises in large area or high frequency CCP, and its prevention are discussed as well. The application of multi-frequency and pulse modulation to CCP and its advantages are analyzed using a simplified circuit modeling. For inductively coupled plasmas (ICP), coil design to reduce the non-uniformity is mainly discussed, and the effects of stray capacitance or skin depth are also dealt. Ground path and symmetry, common issues of the RF plasma source design, should be considered with care to reduce parasitic plasmas and non-uniformity.