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Dry Etching of Si_3N_4, SiO_2 and Si Using Remote Plasma Sources Sustained in NF_3 Mixtures[1] SHUO HUANG, U. Michigan, VLADIMIR VOLYNETS, SANGHEON LEE, IN-CHEOL SONG, SIQING LU, Samsung Electronics Ltd., JAMES HAMILTON, JONATHAN TENNYSON, U. College London, MARK J. KUSHNER, U. Michigan — Remote plasma sources (RPS) are used in microelectronics fabrication to produce fluxes of radicals for etching and passivation in the absence of damage by charging and energetic ions. RPS reactors use distance and grids to reduce or eliminate charged particle fluxes from reaching the wafer. Nitrogen trifluoride (NF_3) is often used in RPS due to the efficiency of producing F atoms by dissociative attachment. RPS sustained in NF_3 gas mixtures, such as $Ar/NF_3/O_2$, increases the variety of reactive species, for example, N_xO_y and FO, and so may enable optimization the etching rates of Si_3N_4, SiO_2 and Si. Meanwhile, by using pulsed power or pulsed gas sources, fluxes of F, O and N_xO_y may be optimized to achieve various etch rates. In this paper, we report on a computational investigation of RPS sustained in different NF_3 containing gas mixtures at pressures of less than a few Torr using continuous and pulsed power for low-damage plasma etching applications. The electron impact cross sections for NF_3, NF_2, and NF were produced using ab initio computational techniques based on the molecular R-matrix method. A reaction mechanism was developed for plasmas sustained in $Ar/NF_3/N_2/O_2$ mixtures and a surface reaction mechanism was developed for etching of Si_3N_4, SiO_2 and Si. Plasma properties and etch rates will be discussed for different pulse-power scenarios and gas mixtures.

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