ClF_3/H_2-plasmaassisted thermal etching of Si_3N_4

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Assemiconductor devices become miniaturized and integrated, the controllabilityof precise etching process becomes increasingly important for the fabricationof nanoscale devices, and selectivity etching techniques for varioussemiconductor materials are required. In addition, among these materials thatrequire selective etching, a technique capable of selectively etching Si_3N_4which is a silicon-based material with excellent properties such as thermalstability at high temperatures, excellent insulation properties and preventionof dopant diffusion is required for the fabrication of nanoscale semiconductordevices. In this study, a selective etching of Si_3N_4 overSiO_2 was investigated by using a remote plasma assisted thermal etchprocess using decomposed chlorine and fluorine radicals of highly reactive ClF_3gas. The ClF_3-plasma assisted thermal etching was evaluated throughvarious process conditions by adding hydrogen gas for improving the etchselectivity of Si_3N_4 over SiO_2. In theoptimized process condition of remote plasma and the substrate temperature of100 °C, the etch rate of Si_3N_4 was about 170 nm/min andthe etch selectivity of Si_3N_4 over SiO_2increased with increasing hydrogen gas content into ClF_3 gas. Also,atomic force microscopy (AFM) and scanning electron microscopy (SEM) were usedto analyze the surface state before and after ClF_3/H_2-plasmaassisted thermal etching.