P2-P009

Effect of N2/Ar flow rates on Si wafer surface roughness during high speed chemical dry thinning

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In this study, we investigated the evolution and reduction of the surface roughness during the high-speed chemical dry thinning process of Si wafers. The direct injection of NO gas into the reactor during the supply of F radicals from NF3 remote plasmas was very effective in increasing the Si thinning rate, due to the NO-induced enhancement of the surface reaction, but resulted in the significant roughening of the thinned Si surface. However, the direct addition of Ar and N2 gas, together with NO gas, decreased the root mean square (RMS) surface roughness of the thinned Si wafer significantly. The process regime for the increasing of the thinning rate and concomitant reduction of the surface roughness was extended at higher Ar gas flow rates. In this way, Si wafer thinning rate as high as 20 μm/min and very smooth surface roughness was obtained and the mechanical damage of silicon wafer was effectively removed. We also measured die fracture strength of thinned Si wafer in order to understand the effect of chemical dry thinning on removal of mechanical damage generated during mechanical grinding. The die fracture strength of the thinned Si wafers was measured using 3-point bending test and compared. The results indicated that chemical dry thinning with reduced surface roughness and removal of mechanical damage increased the die fracture strength of the thinned Si wafer.