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Reduction of surface roughness during high speed thinning of silicon wafer

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In this study, high-speed chemical dry thinning process of Si wafer and evolution of surface roughness were investigated. Direct injection of NO gas into the reactor during the supply of F radicals from NF_3 remote plasmas was very effective in increasing the Si thinning rate due to the NO-induced enhancement of surface reaction but thinned Si surface became roughened significantly. Addition of Ar gas, together with NO gas, decreased root mean square (RMS) surface roughness of thinned Si wafer significantly. The process regime for the thinning rate enhancement with reduced surface roughness was extended at higher Ar gas flow rate. Si wafer thinning rate as high as 22.8 μm/min and root-mean-squared (RMS) surface roughness as small as 0.75 nm could be obtained. It is expected that high-speed chemical dry thinning process has possibility of application to ultra-thin Si wafer thinning with no mechanical damage.