

Characteristics of particulate generated by dry laser stripping of positive photoresist on glass wafer

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Abstract

The characteristics of particles during the stripping of photoresist by ns-pulsed UV laser were investigated. For optically transparent substrate like glass wafer, laser irradiation from backside of wafer was more effective for the photoresist stripping than that from front-side of wafer. The difference between irradiation directions was caused by the enhancement of mechanical effect in backward laser irradiation.

Keywords: pulsed laser, dry stripping, photoresist, nanoparticle

1. Introduction

Laser cleaning technology is new promising dry cleaning technology for particulate and other contaminants. Normally cleaning process is the pre- or post-process for etching, lithography, CMP, deposition and closely related to productivity, uniformity, reproducibility of each process. Especially photoresist stripping is an inevitable post lithography process. Dry laser cleaning has several advantages in contrast to the conventional wet cleaning method (Lu et al, 2000). There have been many studies to understand the mechanism of laser cleaning, but most work focused on the cleaning of particulate. Recently laser cleaning of organic contaminants like photoresist has been researched, but the mechanism and characteristics of cleaning have not been fully understood. (Y. Feng et al., 1999; H.J. Kim et al., 2004). By investigating the characteristics of particles during laser stripping, the cleaning mechanism of film-type organic contaminants could be reasoned.

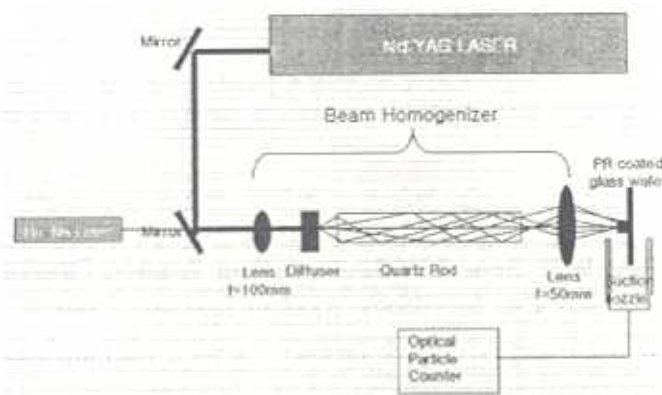


Figure 1. Experimental setup

2. Methods

Nd:YAG pulsed laser(Qanta-Ray PRO 230) was used as a laser source. A photoresist sample prepared by spin-coating AZ1512 positive photoresist on 4" glass wafer and samples were hard baked for 30 min at 120°C. Laser pulses of 2nd harmonic and fundamental wavelength were ineffective for the stripping of photoresist on glass wafer. 3rd harmonic laser pulse could effectively strip the photoresist layer on glass wafer. The maximum energy per pulse, pulse duration and repetition rate of 355nm laser are 300mJ, 7ns, and 30Hz, respectively. Laser particle counter (MicroAir 5230A) was used for the measurement of generated particles. The surface of glass wafer after laser irradiation was observed by a microscope(Nickon, Max 2000X)

3. Results

As shown Fig. 2, laser pulse from backward direction can more effectively strip PR on glass wafer than that from forward direction. A particle size distribution by laser irradiation direction is shown at Fig. 3. The portion of larger particle in backward irradiation was greater than that in forward irradiation. From these results, it could be reasoned that the mechanical effect in stripping was higher than thermal effect with backward laser irradiation. If thermal effects are dominant, nanoparticles are generated by the nucleation of photoresist vapor, because most of photoresist is removed by evaporation.

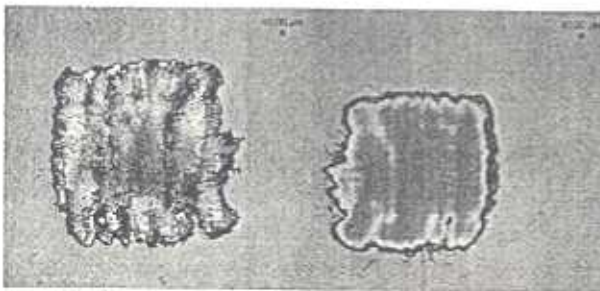


Figure 2. Microscope image at $2\text{J}/\text{cm}^2$
(Left: forward Right: backward)

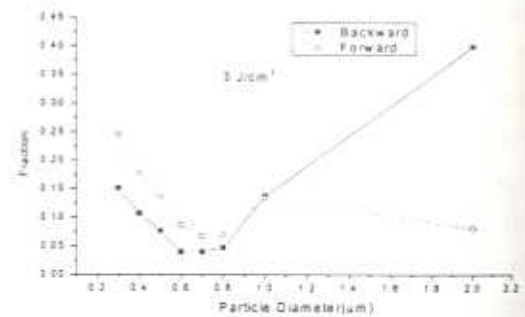


Figure 3. Particle size distribution at $3\text{J}/\text{cm}^2$

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