PROCESS ENHANCEMENTS USING DEEP UV

With the ever-increasing push toward smaller geometries, tighter critical demensions (C/D's), and heavy emphasis on dry processing techniques, process engineers are being forced to develop technology which gives better control of the key factors which impact yield.

The use of Deep UV Radiation to enhance photolithographic processes is rapidly gaining popularity as process engineers recognize its potential on an increasing number of front-end processing applications.

MULTILAYER PROCESSES

The application of two or more resists to planarize and act as a conformal mask on the wafer has dramatically improved the ability of steppers to produce fine line patterns over steps and other deep topography. PMMA (the planarizing layer) requires an exposure of about 1.3 Joules/cm^2 per micron thickness (measured using the DUV 220 probe). A typical exposure time for PMMA (the Deep UV resist) is about 35 seconds per micron thickness, when exposing a 4" (100mm) wafer.

Portable conformal masking (PCM) has already produced submicron geometries with height-to-width ratios in excess of 5:1 (GaAs FET'S).

RESIST STABILIZATION PROCESSES

One of the more outstanding applications of deep UV irradiation of photoresist is its use to crust the top layer of positive photoresist. This confines the resist from flowing during hard bake by stabilizing (or setting up) the upper layer (250 angstroms deep) of the resist. The resist inside the crust is held in position while the higher bake temperatures are applied. This process is used to **increase** the photoresist's **resistance to etchants and plasmas.**

In another application, the resist is stabilized sufficiently that the wafer can be placed in an **implanter** without the need for hard bake. With the hard bake eliminated, the resist after implant remains strippable with common solvents.

For resist stabilization to occur, the radiation should be less than 300nm. Many resists, however, work better with radiation of less than 275nm. To stabilize the resist for lower temperatures (160°C), a little over 1 Joule/cm^2 is required. Bake temperatures of 180°C require 2.5 to 3.5 Joules/cm^2.

Resist stabilization for implant processes require about 2 to 4 Joules/cm^2 to work properly. Energy is measured using a DUV 254 Probe.

A typical production DUV source for 4" (100mm) wafers requires about 50 seconds per wafer for a 170- 180°C temperature hard bake. **Note: Certain resists can be made to stabilize faster when heated during the exposure process.**

Photolithographic Products Division • 2227 Paragon Drive • San Jose, CA 95131 • (408) 942-1050

TECHNOTES

One additional process which has recently began to emerge is the use of DUV hardened resist as an **insulating layer.** In this application, the resist is irradiated with radiation of less than 275nm with a total of about 1 Joule/cm^2. The wafer is then baked in a stepped manner to 180°C. The resist then becomes virtually unstrippable by any reasonable technique. (Energy is measured using the DUV 254nm Probe.)

HTG maintains a growing file on papers involving DUV applications for its customers. If you wish selected copies, please contact us.