HD Microsystems Polyimide PI 2611

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Purpose: To obtain thin films of polyimide for MEMS devices using HD Microsystems Polyimide PI 2611.

Preparation and Precautions:
The polyimide is to be stored in the freezer (Temperature = -18°C) when not in use. Warm to room temperature (at least one hour) before using. PI 2611 is a combustible liquid. Handle with care especially near the hot plate. Breathing vapor may cause nose and throat irritation. Contact may cause skin and also eye irritation. The usage of chemical gloves is strongly recommended.

Polyimide Properties:
PI 2611 is a low moisture, low stress (CTE = 5 ppm) and high modulus of elasticity (8.5 GPa) polyimide from HD Microsystems designed for MEMS applications such as semiconductor and packaging dielectric as well as substrate material. The polyimide could be patterned using dry etching techniques as well as TMAH etching (for example: developers MF 319 and AZ 300). Film thicknesses in the range 4–8 µm can be obtained in a single coat with good uniformity by varying spin speeds in the range 5000 – 1000 rpm. The polyimide substrate can withstand metal sputtering such as Cr, Au and Al without substantial damage.

Procedure:
1. Clean the wafer using a standard base clean (Initial wafer clean SOP).

2. Evaporate the excess moisture present on the surface of the wafer by a dehydration bake (Vacuum dehydration bake SOP).

3. Coat the wafer with polyimide PI 2611. Pour enough polyimide to cover about 20% of the wafer and follow the instructions given in Spinning using the Solitec 5100 spinner SOP. The desired thickness of polyimide will determine the spin speed to be used. The spin parameters for a thickness of 5 µm are as follows:
   Spread : 100 rpm for 5 secs
   Spin : 2500 rpm for 30 secs
   Ramp : 1800 rpm/sec

4. Examine the wafer for a streak free uniform film. If improper coverage is obtained repeat steps 1-3 after stripping the polyimide off with plasma ashing using the RIE.

5. Soft bake the polyimide-coated wafer on the Data Plate programmable hot plate for a temperature range 40°C - 140°C. Increase the temperature in intervals of 10°C very slowly. A very slow ramp rate which can increase the temperature in about 1.5 hours can also be programmed into the hot plate.
   [Note: Soft bake very slowly in order to avoid bubbles in the polyimide film].
6. Cure the polyimide completely in the Suss bonder in an atmosphere of nitrogen. Typical temperature range is 100°C - 350°C with a very slow ramp rate as given in Fig. 1. The recipe used for a polyimide thickness of 5 µm in the Suss bonder is named poly2.rcp.

Fig. 1. Temperature Profile for Suss Bonder (not drawn to scale)

7. Inspect the wafer under the microscope to make sure that there are no bubbles in the polyimide film.

8. Multiple layers of polyimide film can be obtained by following steps 3-7 consecutively with an oxygen plasma step in between using the March RIE to roughen up the polyimide for better adhesion with the following typical parameters.
   Pressure: 250 mtorr
   Power: 300 RF Watts
   Time: 1 min
   Gas Flow: 20 sccm Oxygen