

PTFE Plasma Process

PCB Plasma Etchback Uniformity

Process uniformity represents the main challenge to obtaining repeatability of plasma etchback. Laminate material variables include resin type, degree of resin cure, drilling parameters, bake parameters, and thermal mass of the product. Equipment uniformity is improving with new systems to control chamber temperature, product temperature, and periodically move the product within the plasma to minimize localized field effects. Operating controls have been refined to control input gas mix, flow rates, operating pressure, and pump rate. Improved results may be obtained using older plasma equipment with minor retrofits and specific operator intervention.

Typical Process Cycle

The typical plasma cycle contains three steps; an oxygen / nitrogen burn to raise the product temperature, a main process cycle, and an oxygen burn to remove residues.

The first cycle is usually an 80% oxygen / 20% nitrogen mix to raise the product temperature to 70-90 C, to establish a consistent starting temperature for the second cycle. This step may use high power. The control mode should vary time to achieve the product temperature set point.

The second cycle performs etchback on thermoset resins or prepares the thermoplastic resins for further steps. The usual gas mix is 10% CF₄ / 80% O₂ / 10% N₂ for thermoset resins. Satisfactory results have been obtained for thermoplastic resin systems using a variety of gas mixes, including 80% H₂ / 20% N₂, or 80% N₂ / 20% O₂, or 100% N₂. The rate of reaction rises exponentially with increasing temperature so it is important to balance power input with thermal load to limit the final product temperature to 100-110 C on thermosets. Limit operating pressure to 150-200 milliTorr to increase consistency in high aspect ratio holes. Current density effects may vary results within a panel.

The third cycle is usually 100% O₂ for 5 minutes at 50-75% of full power. This cycle removes process ash and residual unreacted resin components.

PTFE resin systems do not exhibit measurable weight loss after 72 hours of continuous plasma processing. SEMs of the PTFE resin surface indicate sodium etching has a deeper surface effect than plasma, supporting the evidence that sodium processing has a longer shelf life than plasma.

Excess moisture or debris inside the plasma chamber can impede the rate of reaction. Electrode cleaning recommendations can be obtained from the equipment manufacturer. Mechanical cleaning methods will alter the RF properties of the electrodes and should not be used.

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