APPLICATION NOTE

Etching of GaAs

Seperating Effects of Temperature and Power

The Problem:

High rate uniform masked etching of GaAs is needed for device processing requirement such as via formation and die separation. Such applications typically require control of etched areas by photoresist masking, very little undercut of the photoresist relative to the depth of the etch, and high selectivity of substrate etch versus photoresist etch.

Typically the variables tested in the process definition phase for a specific plasma etch method are: RF power input, etch gas species and concentration, gas flow rate, and system pressure. Temperature is not studied as a variable because historically it could not be measured and controlled.

In a typical etch-rate study, wafers are either laid or mechanically clamped onto a platform (usually one of the system electrodes). This assembly, at the vacuum levels at which these processes operate, does not provide good conductive heat transfer from the wafer to the platform. Thus, cooling of the wafer platform has little or no effect on the wafer temperature. Also, one cannot use thermocouples, thermistors, or RTDs in an RF or microwave environment because of the currents induced in the metallic leads which mask the true sensor output of those temperature sensing systems. Thus, researchers were caught in a "Catch-22". If one cannot control temperature, why measure it; conversely, if one can not measure temperature, why try to control it?

The Solution:

Researchers at Bell Communications Research and AT&T Bell Laboratories, studying magnetron-enhanced reactive ion etching (MRIE) of GaAs, wished to study the effects of temperature variations of the GaAs wafer during etching. To provide better conductive heat transfer, they added a layer of thermally conductive grease between the wafer and the cathode assembly. They they used a Luxtron Fluoroptic® temperature sensing system to measure front-side wafer temperature.

Figure 1 shows the temperature rise for a wafer that is not well heat sunk. The wafer temperature rises to 180 C within 3.5 minutes under 400 Watts of RF power. This temperature is high enough to char most photoresists. However, a well heat sunk wafer's temperature can be controlled, in this case, at a temperature of 82°C after one minute at a power input of 800 Watts.

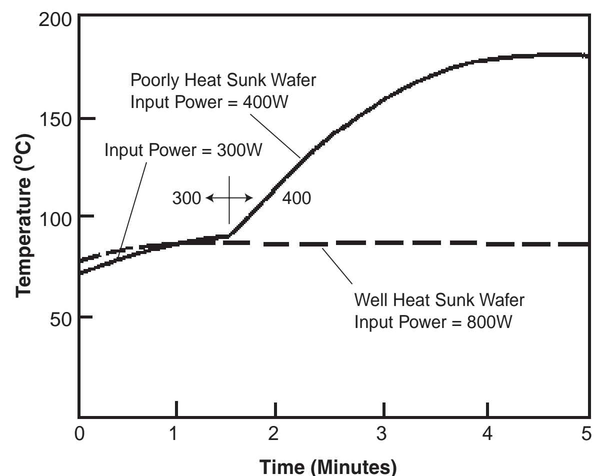

Figure 1: Temperature Rise of a Wafer

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