DRY WIDE RECESS PROCESS CHARACTERIZATION FOR PHEMT

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Abstract

The dry wide recess etch process requires a plasma platform capable of low bias power and low pressures; it targets removal of the GaAs layer and stops on AlGaAs, shown in Figure 1. The SPTS, a new plasma etch platform was installed for this purpose - to increase manufacturing productivity for PHEMT devices and replace older equipment. This process currently runs on PMT Pinnacle and Renaissance tools, both using a MORI source for its plasma. The SPTS platform uses an ICP source located closer to the wafer than the MORI source bell-jar. The new platform with its inherent differences required the characterization procedure for dry wide recess prior to release.

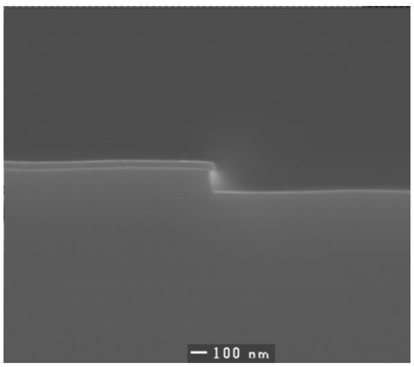

Figure 1: Dry wide recess cross section

The characterization experiment was run with virgin GaAs mechanical wafers with a pre-defined oxide hard mask pattern. These specific wafers were chosen to ensure accuracy of results. How the accuracy of these wafers was discovered will be further discussed in the paper. Then the characterization experiment was done in two steps: screening design of experiment (DOE) and a full factorial DOE.

A screening DOE was created based on the process of record, Table 1. The screening DOE samplesa a portion of the process space to gain an idea of its behavior. The results indicated the processes sensitivity bias and coil power at low process gas flow, resulting in a slow etch, Figure 2.

Pressure	Coil Power	Bias Power	Gas Flow
2.5	350	15	8

Table 1: Process of record

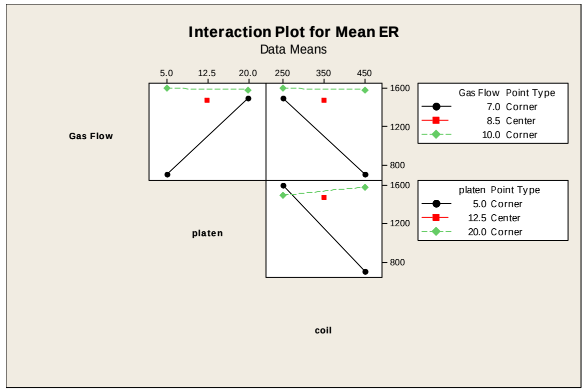

Figure 2: Mean etch rate interaction plot of screening DOE

Based on the screening DOE, a full factorial DOE was created to better investigate the entire process space. The process gas flow was increased in order to avoid the slow etch region of the process space. At the same time, the GaAs and oxide mask selectivity was investigated. Even with a higher process gas flow, the process etch stability still showed signs of susceptibility to coil power, Figure 3. Process Gas flowing at 9sccm or 10sccm is clearly more stable.

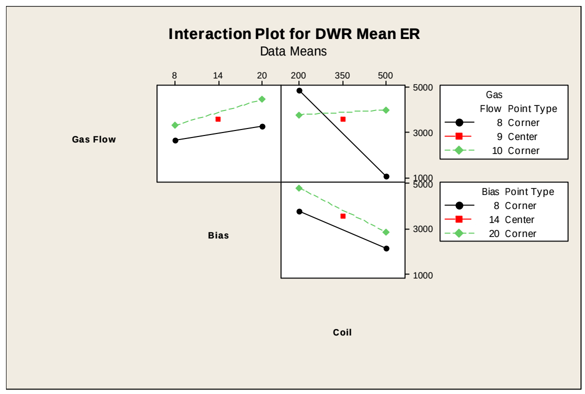

Figure 3: Mean etch rate interaction plot of full factorial DOE

The selectivity of GaAs versus oxide results indicated a significant decrease in selectivity as bias and coil power are increased, Figure 4. More information will be included in the paper regarding this phenomenon. Also, with an increase in process gas flow, the selectivity increases, indicating the effectiveness of this process gas as a GaAs etchant. The implications of this result will be further discussed in the paper.

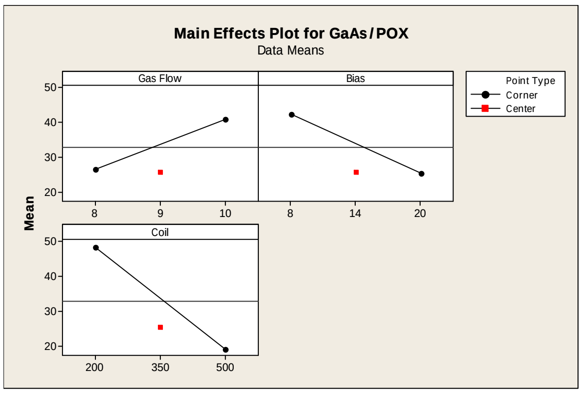

Figure 4: Selectivity of GaAs/Oxide

With the data, the recommended optimum dry wide recess process for the SPTS platform would then be one that runs with process gas flow at 9sccm, 12W bias and 300W coil power to avoid decrease in selectivity, Table 2.

Pressure	Coil Power	Bias Power	Gas Flow
2.5	300	12	9

Table 2: Optimum dry wide recess process

The screening DOE and the full factorial DOE led to new insights about the dry wide recess behavior as well as a new manufacturing process that can be utilized on the SPTS platform. More investigation will be conducted in the future to further our understanding of this process; these plans will be discussed in the full paper.