Influencing Transistor Parameters through Control of the Oxygen Ambient during Rapid Thermal Anneal

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As has been shown in previous articles, the gas ambient can alter the results of a Rapid Thermal Anneal (RTA). In this work, a high volume production facility identified a mismatch between RTA chambers. After a thorough effort to prove the match of temperature, time, uniformity… the mismatch was identified to be due to variations in the percentage of oxygen in nitrogen during the anneal.

During the attempt to identify the mismatch, much of the data confused the analysis. For example, previous transistor technologies did not show a mismatch. It only became evident after a significant volume of the new transistor technology could be analyzed. In addition, the mismatch was evident at only one of the high temperature (S/D) anneals, but not the other.

The single largest transistor parameter to show the mismatch was overlap (Miller) capacitance. It is assumed the difference in oxygen drove differences in dopant diffusion which varied the capacitance. Other transistor parameters showed differences (including the highly important transistor drive current) which were all related to the offset in overlap capacitance.

The difference in oxygen percentage was due to operating the oxygen Mass Flow Controllers (MFC) at the limit of their range. By moving to more optimally sized MFCs, the mismatch was eliminated.

This paper and presentation will display the data which showed the mismatch, the experiments used to identify the offset, the results of those experiments, and the sensitivity of the transistor parameters to oxygen concentration.