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Replacement of C-V Monitoring with Noncontact Cos Charge Analysis

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Modern semiconductor processing facilities often rely heavily on capacitance voltage (C-V) analysis for verification of oxidation furnace cleanliness, both in production and in research and development laboratories. C-V provides an accepted set of electrical test parameters (Vib, Qm, Tox, Dit, etc.) that can be used to monitor tube contamination levels during hot processing as well as pre- and post-processing effects such as preclean condition and post-anneal effectiveness. However, two significant drawbacks of the C-V technology are a) the need for costly and time consuming deposition of MOSCAP electrodes, and b) the reduction in electrically active contaminants due to the MOSCAP processing sequence. A commercially available noncontacting technology called corona-oxide semiconductor (COS) analysis is described here that does not require post-oxidation processing but does measure the fundamental electrical test parameters required for process control and development. Examples of COS in-line process monitoring are presented here, and they we compared directly with traditional polysilicon gate MOSCAP results. Mobile charge, fixed oxide charge, and Si/SiO interface trapped charge were each intentionally introduced to study the detection limits of the techniques. A systematic analysis of the data demonstrates that the strong gettering, cleaning and annealing action of the polysilicon gate deposition process reduces the contamination levels measured by C-V. While the reduced contamination is desirable in terms of ultimate device performance, it is counterproductive when the goal is the monitoring of daily tube contamination levels. The noncontact COS technology is shown to be significantly more responsive to electrically active contaminants, and the data indicate that this difference in sensitivity is due to the immediate, processing-free nature of the COS technology.

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