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Integrated Monitoring of Step Height in SRAM Cell for STI CMP

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Abstract

In ULSI manufacturing, Step Height (SH) between the Field oxide surface and the silicon substrate is an important integration metric known to impact overall transistor performance and ultimately device yield. SH is influenced by multiple components, of which shallow trench isolation (STI) - chemical mechanical polishing (CMP) process is known to be one of them.

Like any CMP process, STI CMP is a pattern dependent process and the correlation between SH in high density SRAM cell and the nitride thickness in the traditional optical measurement location gets weaker with ever shrinking feature sizes. Hence it is becoming crucial to monitor the true SH in the SRAM cell. In order to improve SH C_{pk} , it is necessary to have a measurement capability immediately after the polish step and monitor SH on every wafer.

In this paper, we discuss the importance of SRAM step height control and present an integrated non-contact, non-destructive optical method to monitor it in real-time. The paper presents an overview of the measurement technique and its benefits, which include cycle time reduction and opportunity for closed loop, automated process control (APC). The results from the work successfully demonstrate the capability to measure the nitride thickness in an SRAM cell. Presented TEM and AFM correlation shows the ability to monitor the true step height after STI CMP in high volume manufacturing.

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