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A high-endurance (>>100K) BE-SONOS NAND flash with a robust nitrided tunnel oxide/si interface

Publisher: IEEE

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For Solid-State Drive (SSD) applications cycling endurance of NAND flash is a critical challenge. In this work the endurance reliability of BE-SONOS NAND is thoroughly ex... **View more**

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Abstract:

For Solid-State Drive (SSD) applications cycling endurance of NAND flash is a critical challenge. In this work the endurance reliability of BE-SONOS NAND is thoroughly examined. Using dual CV/IV tests the impact of interface state (Dit) generation/annealing and real charge trapping (Q) on the endurance degradation has been clearly identified. For BE-SONOS with pure thermal oxide O1, the endurance degradation mainly comes from Dit generation at Si/O1 interface, while charge trapping in the thin ONO barrier is negligible even after 100 K cycles of stressing. Meanwhile, the high-temperature V_T loss mainly comes from interface state annealing, while the real charge loss due to electron de-trapping is much smaller. This indicates that our nitride-trapping device has “deep” traps that well retain charges even after the tunnel barrier is damaged. Based on this understanding, we have introduced nitrided O1 to strengthen the Si/O1 interface, and both the endurance and retention are greatly improved. We demonstrate high-endurance BE-SONOS NAND devices of P/E > 5K for MLC and P/E > 100K for SLC operations with excellent retention, promising for solid-state drive (SSD) applications.

Published in: 2010 IEEE International Reliability Physics Symposium

Date of Conference: 02-06 May 2010

DOI: 10.1109/IRPS.2010.5488698

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Date Added to IEEE Xplore: 17 June 2010

Publisher: IEEE

► ISBN Information:

Conference Location: Anaheim, CA, USA

▼ ISSN Information:

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I. Introduction

Charge-trapping (CT) devices promise to continue the NAND-Flash scaling and open the door for 3D NAND Flash. BE-SONOS [1], [2] is one of the promising solid-state architectures and mass-production proven materials of oxide, nitride and poly gate. These well understood materials help further improve the reliability.

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