Conductive Oxide Electrodes Improve Retention in Flash Memory Systems

Beamline: X24A

Category of Researcher: PRT member

Technique: HAXPES

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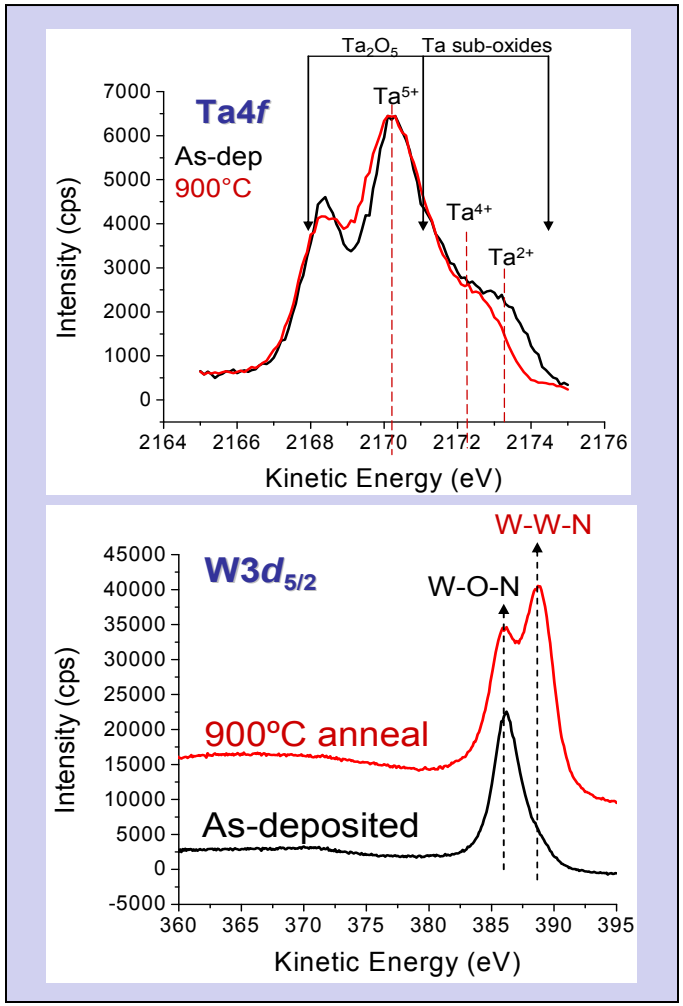
Motivation: Oxygen bearing high effective work function electrodes such as WON have exhibited retention improvement relative to non-oxygen bearing electrodes such as WN, TaN, etc. Identifying physical evidence for this difference is fundamental to modeling and process optimization of flash memory devices.

Results: HAXPES of TaN and WON core lines from 3.5 nm electrode layers on Al_2O_3 has elucidated a fundamental interaction consistent with performance data. The Ta core line illustrates appreciable oxidation as deposited with very slight reduction due to 900 °C anneal while the W core line is highly oxidized as deposited and somewhat reduced due to 900 °C anneal. TaN getters oxygen from Al_2O_3 whereas WON appears to passivate V_0 in Al_2O_3 and improve retention performance.



The Ta 4f and W 3d HAXPES core line spectra of TaN and WON, respectively, on Al_2O_3 captures the critical transfer of oxygen corresponding to improved retention behavior in flash memory devices. TaN getters O from Al_2O_3 while WON appears to passivate V_o in underlying Al_2O_3.