Memory characteristics of Cobalt–Silicide nanocrystals embedded in HfO$_2$ gate oxide for nonvolatile flash devices

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Cobalt-Silicide (CoSi$_2$) nanocrystals (NCs) were investigated for use in charge storage for metal oxide semiconductor (MOS) devices with thin HfO$_2$ tunneling and control oxide layers. CoSi$_2$ NCs were synthesized by exposure of Co/Si/HfO$_2$ tunneling oxide/Si stacks to an external UV laser (Nd:YAG, wavelength 355nm). The thicknesses of the Co and Si layers were intentionally controlled to obtain ideal CoSi$_2$ NCs. Cross-sectional high resolution transmission electron microscopy (TEM) analysis of CoSi$_2$ NCs reveal distinct lattice fringe patterns, indicating the highly crystalline nature of the CoSi$_2$ NCs. Observations from x-ray photoelectron spectroscopy and TEM clearly confirm the formation of CoSi$_2$. These CoSi$_2$ NCs in MOS devices exhibited a large memory window of 3.4V as well as efficient programming/erasing speeds and good retention and endurance times.