

Nonvolatile memory with phosphorous doped Si NCs

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Si NCs memories are promising candidate to overcome the above mentioned limitations of the floating gate nonvolatile memory devices. However, there are some issues that must be resolved prior to the practical applications, one of the most important is that Si NCs floating gate nonvolatile memory didn't show good retention time characteristics. In this study, we controlled depth of potential well of Si NCs by phosphorous doping for the improvement of electron retention characteristics.

Phosphorous doped Si NCs floating gate was deposited on the tunnel oxide grown by furnace using pure Si₂H₆ as source gas and the 5% PH₃ diluted He as doping gas in the low pressure chemical vapor deposition. We used the digital gas feeding method to obtain Si NCs with a uniform size and high density and form Si NCs with FWHM of 6±1 nm and a density of 7×10¹¹ cm⁻².

Threshold voltage shift was 2V to the right when the electron charging voltage was 25 V. However, hole charging wasn't shown in phosphorous doped Si NCs because of ionized phosphorous ion charged positively. The electron retention characteristic of nonvolatile memory with the phosphorous doped Si NCs was better than the undoped Si NCs NFGM.