Abstract

We demonstrated SONOS flash memory with a SiO$_2$/High-k/SiO$_2$ structure based on a 2-bit/cell scheme. We evaluated three kinds of high-k dielectric films which were Si$_3$N$_4$, Al$_2$O$_3$ and HfO$_2$. Among these films, Al$_2$O$_3$ showed superior retention characteristics. The charge loss amount of Al$_2$O$_3$ at 150 $^\circ$C is almost the same as that of Si$_3$N$_4$ at 25 $^\circ$C. HfO$_2$ showed poor retention characteristics. In addition, we have found that each film has a different charge loss mechanism. We speculate that Si$_3$N$_4$ causes vertical charge migration, Al$_2$O$_3$ causes scarcely any leakage, and HfO$_2$ causes lateral charge migration. As a consequence, Al$_2$O$_3$ is very suitable for a charge trapping layer in multi-bit SONOS memory.