Molecules as Segmented Storage Elements in Floating Gate Memories

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Conventional flash memories may reach fundamental scaling limits [1] because of the minimum tunnel oxide thickness and poor charge retention due to defects in the tunneling oxide, necessitating new approaches to meet the scaling requirements while simultaneously meeting the reliability and performance requirements of future products. In this study we demonstrate alternative nano-segmented floating gate memories using organic molecules as programmable charge-storage and charge-retention elements in capacitive structures. These organic thin films consist of inherently well-ordered planner molecules that are on the order of 1nm in size, representing a uniform set of identical nanostructured charge-storage centers. We investigated and compared the memory behavior of a variety of molecular thin films for identifying the molecular thin-film characteristics best suited for design of floating gate memory. The initial results show device durability over 10^5 program-erase cycles, with a hysteresis window of up to 3.3 V for program/erase conditions of +8V/-8V, corresponding to the charge storage density of 5 x 10^{12} cm^{-2}. These results signify the potential of using molecular organic thin films as a floating gate of flash memory devices.

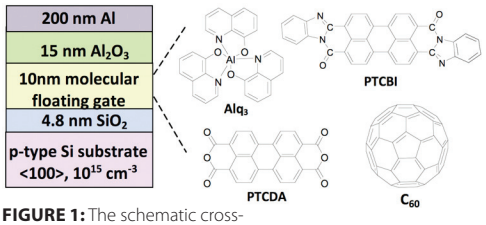

FIGURE 1: The schematic cross-section of the device structure with chemical structures of tested molecular organic thin films.

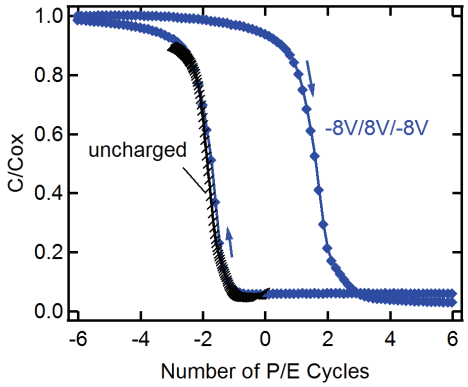

FIGURE 2: The C-*V* plot of a device with a10-nm thick PTCBI layer showing a 3.3±0.1 V hysteresis window.

REFERENCES

[1] Pavan, P., Bez, R., Olivo, P. & Zanoni, E. Flash Memory Cells-An Overview. *Proceedings of the IEEE* **85**, 8 (1997).