World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:17, No:01, 2023

Charge Trapping on a Single-wall Carbon Nanotube Thin-film Transistor with Several Electrode Metals for Memory Function Mimicking

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Abstract : In this study, the charge storage on thin-film SWCNT transistors was investigated, and C-V hysteresis tests showed that interface charge trapping effects predominate the memory window. Two electrode materials were utilized to demonstrate that selecting the appropriate metal electrode clearly improves the conductivity and, consequently, the SWCNT thin-film's memory effect. Because their work function is similar to that of thin-film carbon nanotubes, Ti contacts produce higher charge confinement and show greater charge storage than Pd contacts. For Pd-contact CNTFETs and CNTFETs with Ti electrodes, a sizable clockwise hysteresis window was seen in the dual sweep circle with a threshold voltage shift of V11.52V and V9.7V, respectively. The SWCNT thin-film based transistor is expected to have significant trapping and detrapping charges because of the large C-V hysteresis. We have found that the predicted stored charge density for CNTFETs with Ti contacts is approximately 4.01×10-2C.m-2, which is nearly twice as high as the charge density of the device with Pd contacts. We have shown that the amount of trapped charges can be changed by sweeping the range or Vgs rate. We also looked into the variation in the flat band voltage (V FB) vs. time in order to determine the carrier retention period in CNTFETs with Ti and Pd electrodes. The outcome shows that memorizing trapped charges is about 300 seconds, which is a crucial finding for memory function mimicking.

Keywords : charge storage, thin-film SWCNT based transistors, C-V hysteresis, memory effect, trapping and detrapping charges, stored charge density, the carrier retention time
Conference Title : ICAMST 2023 : International Conference on Advanced Materials Science and Technology
Conference Location : Paris, France
Conference Dates : January 23-24, 2023