

Uncovering the Role of Crystal Phase in Determining Nonvolatile Flash Memory Device Performance Based on 2D Van Der Waals Heterostructures

Authors : Yunpeng Xia, Jijia Zha, Haoxin Huang, Hau Ping Chan, Chaoliang Tan

Abstract : Although the crystal phase of two-dimensional (2D) transition metal dichalcogenides (TMDs) has been proven to play an essential role in fabricating high-performance electronic devices in the past decade, its effect on the performance of 2D material-based flash memory devices still remains unclear. Here, we report the exploration of the effect of MoTe₂ in different phases as the charge trapping layer on the performance of 2D van der Waals (vdW) heterostructure-based flash memory devices, where the metallic 1T'-MoTe₂ or semiconducting 2H-MoTe₂ nanoflake is used as the floating gate. By conducting comprehensive measurements on the two kinds of vdW heterostructure-based devices, the memory device based on MoS₂/h-BN/1T'-MoTe₂ presents much better performance, including a larger memory window, faster switching speed (100 ns) and higher extinction ratio (107), than that of the device based on MoS₂/h-BN/2H-MoTe₂ heterostructure. Moreover, the device based on MoS₂/h-BN/1T'-MoTe₂ heterostructure also shows a long cycle (>1200 cycles) and retention (>3000 s) stability. Our study clearly demonstrates that the crystal phase of 2D TMDs has a significant impact on the performance of nonvolatile flash memory devices based on 2D vdW heterostructures, which paves the way for the fabrication of future high-performance memory devices based on 2D materials.

Keywords : crystal Phase, 2D van der Waals heretostructure, flash memory device, floating gate

Conference Title : ICMON 2024 : International Conference on Microelectronics, Optoelectronics and Nanoelectronic Engineering

Conference Location : Tokyo, Japan

Conference Dates : July 22-23, 2024