High Symmetry and Linearity in Weight Update with GeTe/Sb_2Te_3 Superlattice-like Structure for Artificial Synapse

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Artificial intelligence (AI), which allows us to act and think like humans, has been extensively studied not only in academia but also in society. [1] The von Neumann architecture which conventional computing method generated a bottleneck which is a drawback in the process of transferring data due to the separation of the memory and the computing unit. The human brain which consists of a neural network shows the efficiency and high accuracy of information processing. Therefore, 'neuromorphic computing' was introduced that a new computational method that mimics the biological brain. [2] The emerging nonvolatile memory based on a two-terminal is considered as a device to be applied to neuromorphic computing beyond the limits of silicon-based CMOS. Among them, phase change memory (PCM) is considered a promising candidate for neuro-inspired computing or nonvolatile memory. Recently, there are device structural and material efforts for PCM for artificial synaptic applications. [3] Due to the mechanism of PCM, problems such as high current and asymmetrical resistance change to achieve high resistance still exist. To solve this problem, an interfacial phase change memory (iPCM), in which a superlattice-like structure is created by alternately depositing a GeTe thin film and a Sb_2Te_3 thin film, has emerged. [4] This structure reduces entropy by limiting the atomic movement of Ge atoms by the vdW gap between the GeTe thin film and the Sb_2Te_3 thin film. As a result, low energy consumption and high operating speed can be realized. We present a method to implement artificial synaptic characteristics in iPCM by designing an electric-based pulse scheme with iPCM unique features. It brought about more stable switching than $Ge_2Sb_2Te_5$, which caused many problems with the existing melting process. We implemented a linear and symmetrical conductance transition based on the unique properties of GeTe/Sb_2Te_3 iPCM deposited by sputtering. This will be of great help in utilizing artificial synapses that constitute neuromorphic computing requiring analog transition.

Reference

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