On the modeling of new tunnel junction magnetoresistive biosensors

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Abstract: A fully integrated biochip based on a 16 X 16 scalable matrix structure of aluminum oxide magnetic tunnel junctions (MTJs) and thin-film diodes (TFDs of hydrogenated amorphous silicon) was fabricated and included as the biosensor of a portable handheld microsystem developed for biomolecular recognition detection using magnetic labels [deoxyribonucleic acid (DNA) hybridization, antibody antigen interaction, etc.]. The system uses magnetic field arraying of magnetically tagged biomolecules and can potentially be used to detect single or few biomolecules. Each biosensor matrix node is the series between a TFD (p-i-n or Schottky-barrier type) and an MTJ. In this paper, this matrix basic cell biosensor element is completely characterized and modeled. Experimental measured data are provided and compared with the proposed theoretical models results. It is shown that the diode may be used both as the matrix switching device and as an in-site temperature sensor and that the MTJ may act as the magnetoresistive sensor for detecting the fringe field of immobilized magnetic markers. Therefore, the fabricated fully integrated biochip included in the developed handheld microsystem may be used for biomolecular recognition.

Author Keywords: Biomedical transducers; Magnetoresistive devices; P-i-n diodes; Schottky diodes; System modeling

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