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Selected Papers

Investigation of Ferromagnetic Nanoparticles' Behavior in a Radio Frequency Electromagnetic Field for Medical Applications

Authors: Katarzyna Wojtera, Lukasz Pietrzak, Lukasz Szymanski and Slawomir Wiak

Abstract: This work raises the hypothesis that it is possible to use ferromagnetic carbon nanotubes filled with iron to hyperthermally destroy cancer cells in a radiofrequency electromagnetic field. This paper describes the synthesis process of iron-filled multi-walled carbon nanotubes (Fe-MWCNTs) and presents a study of their magnetic properties. Fe-MWCNTs were synthesized by catalytic chemical vapor deposition (CCVD). Appropriate functionalization properties of the nanoparticles for biomedical applications were used, and their magnetic properties were studied to determine the heat generation efficiency induced by exposure of the particles to an external electromagnetic field. The response of the samples was measured for 45 min of exposure. The results showed an increase in sample temperature that was proportional to concentration. The results of laboratory work were compared to the simulation using COMSOL software.

https://doi.org/10.3390/electronics13122287

A Novel CNFET SRAM-Based Compute-In-Memory for BNN Considering Chirality and Nanotubes

Authors: Youngbae Kim, Nader Alnatsheh, Nandakishor Yadav, Jaeik Cho, Heeyoung Jo and Kyuwon Ken Choi

Abstract: As AI models grow in complexity to enhance accuracy, supporting hardware encounters challenges such as heightened power consumption and diminished processing speed due to high throughput demands. Compute-in-memory (CIM) technology emerges as a promising solution. Furthermore, carbon nanotube field-effect transistors (CNFETs) show significant potential in bolstering CIM technology. Despite advancements in silicon semiconductor technology, CNFETs pose as formidable competitors, offering advantages in reliability, performance, and power efficiency. This is particularly pertinent given the ongoing challenges posed by the reduction in silicon feature size. We proposed an ultra-low-power architecture leveraging CNFETs for Binary Neural Networks (BNNs), featuring an advanced state-of-the-art 8T SRAM bit cell and CNFET model to optimize performance in intricate AI computations. Through meticulous optimization, we fine-tune the CNFET model by adjusting tube counts and chiral vectors, as well as optimizing transistor ratios for SRAM transistors and nanotube diameters. SPICE simulation in 32 nm CNFET technology facilitates the determination of optimal transistor ratios and chiral vectors across various nanotube diameters under a 0.9 V supply voltage. Comparative analysis with conventional FinFET-based CIM structures underscores the superior performance of our CNFET SRAM-based CIM design, boasting a 99% reduction in power consumption and a 91.2% decrease in delay compared to state-of-the-art designs.

https://doi.org/10.3390/electronics13112192

Evaluation of a Simplified Modeling Approach for SEE Cross-Section Prediction: A Case Study of SEU on 6T SRAM Cells

Authors: Cleiton M. Marques ,Frédéric Wrobel,Ygor Q. Aguiar, AlainMichez, Frédéric Saigné, Jérôme Boch, Luigi Dilillo and Rubén García Alía

Abstract: Electrical models play a crucial role in assessing the radiation sensitivity of devices. However, since they are usually not provided for end users, it is essential to have alternative modeling approaches to optimize circuit design before irradiation tests, and to support the understanding of post-irradiation data. This work proposes a novel simplified methodology to evaluate the single-event effects (SEEs) cross-section. To validate the proposed approach, we consider the 6T SRAM cell a case study in four technological nodes. The modeling considers layout features and the doping profile, presenting ways to estimate unknown parameters. The accuracy and limitations are determined by comparing our simulations with actual experimental data. The results demonstrated a strong correlation with irradiation data, without requiring any fitting of the simulation results or access to process design kit (PDK) data. This proves that our approach is a reliable method for calculating the single-event upset (SEU) cross-section for heavy-ion irradiation.

https://doi.org/10.3390/electronics13101954

Shaping of the Frequency Response of Photoacoustic Cells with Multi-Cavity Structures

Authors: Wiktor Porakowski andTomasz Starecki

Abstract: In the great majority of cases, the design of resonant photoacoustic cells is based on the use of resonators excited at the frequencies of their main resonances. This work presents a solution in which the use of a multi-cavity structure with the appropriate selection of the mechanical parameters of the cavities and the interconnecting ducts allows for the shaping of the frequency response of the cell. Such solutions may be particularly useful when the purpose of the designed cells is operation at multiple frequencies, e.g., in applications with the simultaneous detection of multiple gaseous compounds. The concept is tested with cells made using 3D printing technology. The measured frequency responses of the tested cells show very good agreement with the simulation results. This allows for an approach in which the development of a cell with the desired frequency response can be initially based on modeling, without the need for the time-consuming and expensive process of manufacturing and measuring numerous modifications of the cell.

https://doi.org/10.3390/electronics13091786

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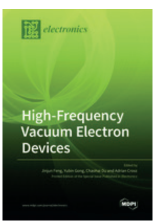

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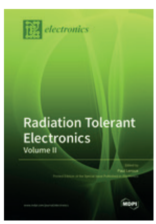

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