5. NANOENGINEERING

5.1. Devices and Sensors

2.5.1.1. The effect of surface recombination on the open circuit voltage of a solar cell based on a single nanowire with a radial p-n-junction. /S.G. Petrosyan, V.A. Khachatryan, S.R. Nersesyan/. Proceedings of NAS RA. Physics. – 2020. – vol. 55. – #3. – pp. 343-357. – rus.; abs.: rus., arm., eng.

An analytical model is proposed for studying the effect of surface recombination on the characteristics of a solar cell based on a nanowire with a radial p-n junction formed between its 'core' and 'shell' of different types of conductivity. When varying over a wide range of shell widths, the effect of surface recombination on such important parameters of a solar cell as short circuit current, open circuit voltage, and the efficiency of solar energy conversation into electrical energy is considered. It is shown that the relatively low open circuit voltage, often observed experimentally in such solar cells, can be caused by significant surface recombination on the sidewall of the nanowire, the role of which increases with decreasing nanowire diameter and increasing surface to volume ratio. Fig. 6, Ref. 27.

Keywords: analytical model, solar cell, conductivity, short circuit current, open circuit voltage, solar energy

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2.5.1.2. Detection of iron nanoparticles in aqueous solutions by microwave sensor. /L. Odabashyan, N. Margaryan, G. Ohanyan, M. Manvelyan, D. Hambaryan, T. Abrahamyan, R. Khachatryan, A. Babajanyan/. Proceedings of NAS RA. Physics. – 2020. – vol. 55. – #2. – pp. 251-258. – rus.; abs.: rus., arm., eng.

The aqueous solution with iron nanoparticles is investigated by a microwave stripline sensor based on the optimized double quadratic-shape design. Due to real-time near- field electromagnetic interaction between microwaves and sample S11, the reflection coefficient of the sensor changed depending on iron

nanoparticles concentration in the aqueous solution at resonant frequency. Thes work examined the iron nanoparticles concentration in the 0–20 μg/l concentration range at an operating frequency at about 1.7 GHz. The measured minimum detectable signal was 0.035 dB/(μg/l) or and 0.25 MHz/(μg/l) and the measured minimum detectable concentration was 1.4 μg/l and 0.2 μg/l, respectively. The microwave response of sensor systems can be explained by the additional structural changes of water clusters due to the metal nanoparticles ablation. This implemented method has approachable development process and the accuracy of measurement is high, thus it can be applied as a physicochemical sensor for non-invasive monitoring of metal nanoparticles in complex liquids. Fig. 4, Ref. 14.

Keywords: iron nanoparticles, microwave stripline sensor, minimum detactable signal, ablation, physicochemical sensor

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2.5.1.3. Gas nanosensors made from semiconductor metaloxides. /V.M. Aroutiounian/. Proceedings of NAS RA. Physics. – 2019. – vol. 54. – #4. – pp. 485-501. – rus.; abs.: rus., arm., eng.

Usually, semiconductor gas sensors made from metal oxides require high pre-heating of the work body. Advantages for nanoscale sensors are the possibility to work at remarkable lower than 300°C temperature of its work body up to room temperature (practically without preheating of the sensor). Today's experimental results obtained for gas sensors made from metal oxides are reported in this review. Fig. 1, Ref. 100.

Keywords: semiconductor, gas sensor, metal oxide, work body, nanoscale sensors, preheating

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2.5.1.4. Electronic and transport properties of boron nitride nanodevice (BNNT). /I.M. Danglyan, E.M. Kazaryan, D.B. Hayrapetyan/. Armenian Journal of Physics. – 2019. – vol. 12. – #4. – pp. 344-348. – eng.; abs.: eng.

Boron nitride nanotubes are valued due to their physical and chemical properties. They can be applied in the field of design and developing of optoelectronic devices of new generation. In this paper, the transport and electronic properties of both pure boron nitride and boron nitride nanotube with embedded carbon atoms have been calculated in the framework of the Density Functional Theory (DFT). The results show that a nanodevice with embedded carbon atoms has wider transmission spectrum than the pure one. Transmission eigenvalues for both nanodevices were computed. A nanodevice with impurity has higher transmission eigenvalues than the pure one. Fig. 4, Tab. 1, Ref. 6.

Keywords: Boron Nitride nanotube, transmission spectrum, eigenvalue, eigenstate

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2.5.1.5. Semiconductor gas sensors using Arduino nano. /V. Aroutiounian, A. Hovhannisyan/. Armenian Journal of Physics. – 2019. – vol. 12. – #4. – pp. 325–328. – eng.; abs.: eng.

A programmable board with its own processor and Arduino Nano memory was used. The board has a couple of dozen contacts, to which all kinds of components (displays, light emitting devices (LEDs), sensors, motors, routers, magnetic locks, etc.) can be connected. A gas detector using Arduino Nano circuit was proposed. Fig. 3, Ref. 9.

Keywords: gas detector, semiconductor, Arduino Nano

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2.5.1.6. Numerical study of Josephson nanostructures using parallel computing. /I.R. Rahmonov, E.V. Zemlyanaya, M.V. Bashashin, P. Atanasova, A.R. Rahmonova, Yu.M. Shukrinov/. Armenian Journal of Physics. – 2019. – vol. 12. – #3. – pp. 233-239. – eng.; abs.: eng.

The phase dynamics of the stack of long JJs, the length of which exceeds the Josephson penetration depth λJ, taking into account the inductive and capacitive couplings between junctions and diffusion current is investigated. Numerical simulation of current-voltage characteristics of the stack is based on numerical solution of a system of nonlinear partial differential equations by the fourth order Runge-Kutta method and finite-difference approximation. The calculations are performed using the MPI technique for parallel implementation. The methodical calculations on multi-processor cluster (LIT JINR) with a different number of parallel MPI-processes are carried out. It is shown that the developed parallel algorithm provides about 7-fold acceleration in comparison with serial simulation. Fig. 2, Tab. 1, Ref. 22.

Keywords: Josephson junction, inductive coupling, capacitive coupling

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