MoRe–based and NbN-based tunnel junctions and their characteristics

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Perspective [1] Josephson Mo-Re alloy-oxide–Pb, Mo-Re alloy-normal metal–oxide–Pb and Mo-Re alloy-normal metal–oxide– normal metal–Mo-Re alloy junctions have been fabricated and investigated. Thin (~50-100 nm) MoRe superconducting films are deposited on Al2O3 substrates by using a dc magnetron sputtering of MoRe target. Normal metal (Sn, Al) thin films are deposited on the MoRe films surfaces by thermal evaporation of metals in vacuum and oxidized to fabricate junctions oxide barriers. Quasiparticle I–V curves of the fabricated junctions were measured in wide range of voltages. To investigate a transparency spread for the fabricated junctions barriers the computer simulation of the measured quasiparticle I–V curves have been done in framework of the model of multiple Andreev reflections in double-barrier junction interfaces. It's demonstrated the investigated junctions can be described as highly asymmetric double–barrier Josephson junctions with great difference between the two barrier transparencies [2,3]. The result of the comparison of experimental quasiparticle I–V curves and calculated ones is proposed and discussed. Results of computer simulation of quasiparticles I-V curves of NbN-based junctions are presented and discussed. Also I–V curves of the fabricated junctions have been measured under microwave irradiation with 60 GHz frequency , clear Shapiro steps in the measured I–V curves were observed and discussed.

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Section III — Novel Materials and Methods

Pressure Dependence of the Fermi energy, Band Gap and Electric Field Gradient

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Recently we have investigated the structural and electronic properties of ZnS using density functional theory (DFT) approach by Wien2k package. The total energy calculations indicate that at zero pressure the wurtzite phase in GGA and GGA-EV approaches and zinc-blend in LDA approach are found to be stable. The band structure calculation within LDA and GGA approaches show that they are not good approaches for ZnS band structure calculations, but the calculated band gaps within GGA-EV are in much better agreement with experimental