

### Four-terminal superconducting heterostructures with hybrid semiconducting barriers and their properties

V.E.Shaternik<sup>1</sup>, A.P.Shapovalov<sup>2</sup>, A.Yu.Suvorov<sup>1</sup>

<sup>1</sup> *G.V.Kurdyumov Institute for Metal Physics of the NAS of Ukraine, 36 Vernadsky blvrd. , -03680 Kyiv-142, Ukraine.:*

*E-mail: [shaternikv@i.ua](mailto:shaternikv@i.ua)*

<sup>2</sup> *V.M. Bakul Institute for Superhard Materials of the NAS of Ukraine, 2, Avtozavodskaya Str., Kyiv, Ukraine.*

Now superconducting computers are designed and developed in the leading world countries because it's expected these computers will have ultra-low power consumption, which will be at least three to four orders of magnitude smaller compared to the current level of consumption of semiconductor computers (in terms of a single operation), which now reaches its upper limit on this parameter.

MoRe-Si(W)-MoRe-Si(W)-MoRe are fabricating by a magnetron sputtering of MoRe and combined Si(W) targets in argon ( $P \sim 0,1$  Pa) with following deposition of the thin films (through metal mask) on polycrystalline  $Al_2O_3$  wafer. We deposit silicon layer in which due to self-organizing effect the tungsten (W) metal quantum dots are forming during the joint deposition of Si and W. As a result the locking layers of space charges are localized in the amorphous silicon layers (named barriers with traps). These barriers with traps behave as the potential barriers for the charge transport.

Firstly, the four-terminal hybrid superconductor- semiconductor (with quantum dots)-superconductor- semiconductor (with quantum dots)-superconductor junctions have been fabricated and their I-V curves have been measured experimentally. It's obtained these heterostrucure demonstrate the switching effect: the voltage value (applied in it) can be controlled by changing the control current value which change (by the current electric field) the height of potential barriers formed by electrons trapped in the traps in silicon layers, as a result the heterostructure I-V curve can be controlled. It's proposed the fabricated heterostructures behave like a transistor and can have voltage and power gains in some frequency range.