MANGANITE BASED MAGNETIC TUNNEL JUNCTIONS ON GRAIN BOUNDARY OF [100]-TILT TYPE: MAGNETORESISTANCE AND MICROWAVE DYNAMICS

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Magnetic tunnel junction (MTJ) as basic device in the field of spintronics have attracted many interest both as physical phenomenon and due to their potential application in electronics. As was recently proved in experiments [1] manganites ($La_{1-x}A_xMnO_3$, where A – Ca, Sr, Ba…) have nearly 100% spin polarization in their ferromagnetic state that makes this material very attractive as a base for MTJ. However due to complex metaloxide nature of manganites fabrication of multilayer MTJ encounter serious problems related with degradation of ferromagnetic properties in the vicinity of interfaces. Recently several works were published where properties of artificial grain boundary MTJ on [001]-tilt bicrystal substrates were studied [2,3]. As it was shown in [4] for high-Tc superconducting Josephson junctions using bicrystal substrates of [100]-tilt type more suitable for making high quality metaloxide tunnel junctions than bicrystals of [001]-tilt type and they show higher I_CR_N product and lower resistance. The aim of the present work is to study transport, magnetoresistive and microwave properties of manganite based MTJ on [100]-tilt bicrystal substrate.

Thin film of $La_{0.7}Ca_{0.3}MnO_3$ ($T_{Curie}\approx 250K$) were deposited by conventional pulsed laser deposition technique on $NdGaO_3$ [100]-tilt bicrystal substrates with misalignment of [001] axis on ±11° or ±14° in plane perpendicular to bicrystal boundary. Manganite thin film were patterned through photoresist mask by low energy Ar^+ ion beam into 8 μm bridges crossing bicrystal boundary. We measured resistance vs. temperature dependence of bicrystal junction excluding resistance of the film taking as a reference R(T) curves of similar bridges without grain boundary patterned on the same substrate. R(T) of the bicrystal boundary resembles the dependences of the film but with much lower T_{Curie}. Voltage dependencies of differential conductance of the bicrystal boundary were measured at several temperatures and in magnetic fields up to 200 mT. σ(V) has sharp dip at zero voltage but rapidly increases and saturates at voltages around 150 mV to the value that corresponds to the conductance of the film without grain boundary. Magnetoresistance at zero voltage and in magnetic field perpendicular to the film of about 40% was obtained at T=4.2K. From our results we conclude that manganite grain boundary has complex structure incorporating both low height tunneling barrier that can be overpowered by applied voltage and layers with significantly suppressed ferromagnetic ordering. Microwave response of voltage biased MTJ with antiparallel magnetization will be presented and discussed.

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