**Thematic area of your work** Nanocomposites and nanomaterials

RF plasma modification of MoS2 2D material

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Single and multy layer MoS2 materials are intensively studied in last decade. Single layer MoS2 material is 2D semiconductor with direct band gap of 1.8 eV which is very promising for next generation of nanoelectronic and optoelectronic devices. Control doping of such 2D layers is impontant point in these research. RF plasma treatment is low temperature methods which allows us to change effectively electrical parameters of the materials. In suggested research the RF plasma of forming gas (10%H2+90%N2) has been used to modificate and doping of the multilayer MoS2 film.

The MoS2 pristine flakes in ethanol/water solution were purcharsed from Graphene Supermarket Co (USA) and deposited on Au interdigitated electrode array (IDA) on SiO2/Si by ultrasonic spray coating technique. The IDA used for electrical and AFM measurments. For Raman, FTIR and XPS experiments the MoS2 flakes were deposited on Si wafer. The samples were treated by RF plasma (13.6 MHz) at room temperature during 30-90 sec at 0.5W/cm2 in forming gas.

It was shown that RF plasma treatment of the flakes results in decrease of differential resistance near zero volt in compare with initial structure, and when a time of the treatment reaches to 90 sec the reduction amounts factor of 100. Raman spectra show characteristic peaks for multilayer MoS2 at 386, 406 and 454 cm−1, which can be assigned to the E12g, A1g and longitudinal acoustic phonon modes, respectively. After RF plasma treatments the E12g and A1g lines are shifted in blue side that corresponds to additional hole doping of the MoS2 flakes. XPS spectra demonstrate presence peaks at 228.5, 320 and 235 eV. Two first ones correspond to the Mo4+ 3d5/2 and Mo4+ 3d3/2 components in 2H-MoS2, and last peak – to Mo6+ 3d5/2 and associated with MoO3 oxide formation. It is known that oxygen incorporation into MoS2 layer can result in additional hole doping. However the MoO3 is wide bandgap semiconductor which has high resistivity and its formation is unable to reduce resistance oft he material. Nitrogen incorporation in oxygen vacancy of the MoS2 can also dope it with holes. Possibly nitrogen doping or formation of MoOX oxides, which can be low resistance, leads to reduction of electrical resistance of MoS2 flakes.