Nanostructured surfaces

Nanoscale conductive channels in silicon whiskers with nickel impurity

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The investigation of behavior of magnetic doping in semiconductor devices is necessary to understand physical process in crystal. It is well known, that the sufficient presence of magnetic impurity can lead to a magnetic cluster formation. Taking into account the information about spin dependence on crystal features it becomes possible to create the nanoclusters which can have an influence on movement of charge carriers in crystal.

The p-type silicon microcrystals doped with boron to concentration in vicinity to dielectric side of metal-insulator transition were chosen as the object of investigation; these microcrystals were grown by CVD method in a closed system containing boron and gold. The diffusion process of nickel into crystal's volume was conducted at the temperature 850 ^{O}C.

To confirm the assumption about the presence of the magnetic moment in crystals there were conducted several experiments of magnetic susceptibility by Faraday method. The obtained results indicate that decreasing temperatures have direct influence on the orientation of magnetic moments in crystal. It can be assumed that there is some orientation of the spins of magnetic impurity at low temperatures and on the other hand there is neglection of the influence of magnetic impurity on nearest environment at increasing temperatures.

To check the our assumption we have conducted comparative investigation of Si p-type crystals with nickel impurity and non magnetic crystals and we have found hysteresis of magnetic moment of crystal. The comparative research of Si whiskers in magnetic field is shown significant influence of nickel impurity on crystal magnetoresistance at wide temperatures range (the strongest effect manifestation occurred at the temperature 4.2 K) - the value of negative magnetoresistance of crystal with magnetic impurity is in 10 times bigger than the value of the crystal without impurity.