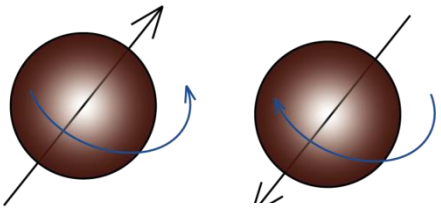
Research (What is it about?)	**Room- temperature ferromagnetism in semiconductors**
UNN authors	*Kudrin A., Danilov Yu., Lesnikov V., Vikhrova O.*
We find (The result)	Ferromagnetic behavior has been demonstrate for *(In, Fe)Sb* layers on *GaAs* substrates at room temperature
Abstract	***Spintronics*** is an emerging field, in which we try to utilize not only charge transport of carriers but also spin degrees of freedom in materials and devices. Metal-based devices are already applied to magnetic-field sensors in hard disk drive systems, greatly contributing to the increase in data storage capacity. They use the spin transport between two ferromagnetic metal electrodes separated by an ultrathin nonmagnetic material. The latter device structure is called magnetic tunnel junction and they used for nonvolatile magnetoresistive random access memory (MRAM). Introducing such spin-related properties in semiconductors is expected to give new spin degrees of freedom in semiconductor devices and electronics. So it needs ***ferromagnetic semiconductors***. They are known with p-type carrier and for low temperatures (up to 60 K). But all of semiconductor devices, including *p-n* junction diodes, field-effect transistors, and semiconductor lasers, require a pair of n- and p-type semiconductor materials to work. The room work temperature of devices are practically essential. The ***n-type*** ferromagnetic *(In,Fe)As* structure at room temperature has been recently produced in Japan. We produce n-type ***(In, Fe)Sb*** layers with a *Fe* content up to 13 at. % which have been grown on (001) *GaAs* substrates using the pulsed laser deposition. Transmission electron microscopy shows that the layers are epitaxial and free of second-phase inclusions. The observation of ***hysteretic magnetoresistance*** curves at temperatures up to 300 K reveal that the Curie point lies above room temperature. The resonant character of magnetic circular dichroism confirms the intrinsic ferromagnetism in the *(In, Fe)Sb* matrix.

Representative articles 2017-2018, quartiles	1. *Kudrin A.V., Danilov Yu.A., Lesnikov V.P., Dorokhin M.V., Vikhrova O.V., Pavlov D.A., Usov Yu.V., Antonov I.N., Kriukov R.N., Alaferdov A.V., Sobolev N.A.* High-temperature intrinsic ferromagnetism in the (In,Fe)Sb semiconductor. J. Appl. Phys. **122**: 183901 (2017).	Q2
	Q-index (Qi) for the result	**3**
	high orange	

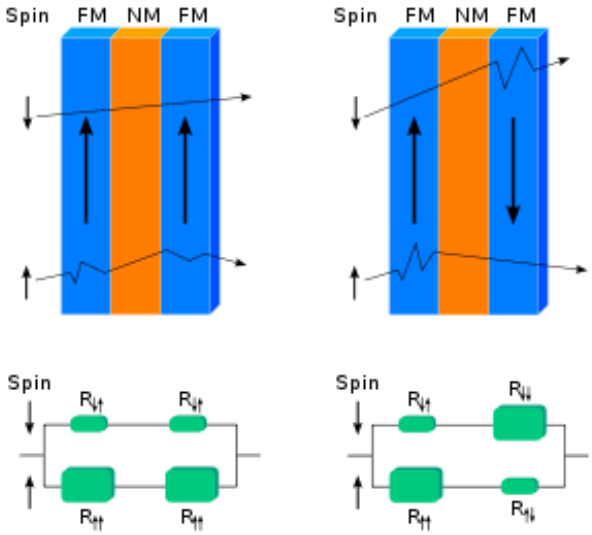
In collaboration	University of Campinas, Campinas BR-13083870, Brazil University of Aveiro, Aveiro P-3810193, Portugal National University of Science and Technology MISiS, Moscow 119049, Russia



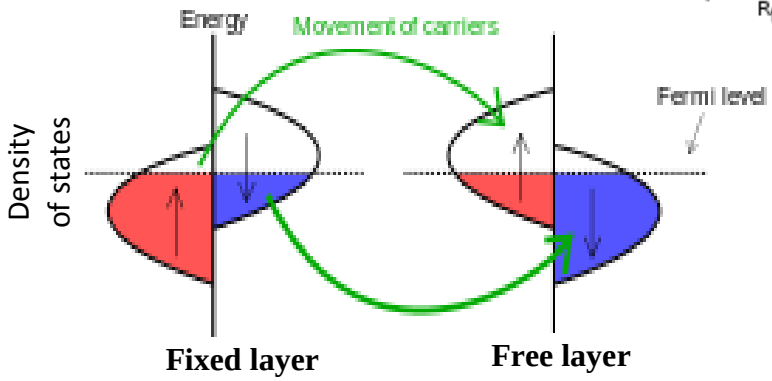
Opposite direction ***spins*** (intrinsic magnetic moments) of two electrons.

Metal-based spintronics

Spin valve based on the ***giant magnetoresistance*** effect: when magnetization in ferromagnetic layers (FM) are antiparallel the resistance is giant (see equivalent scheme).

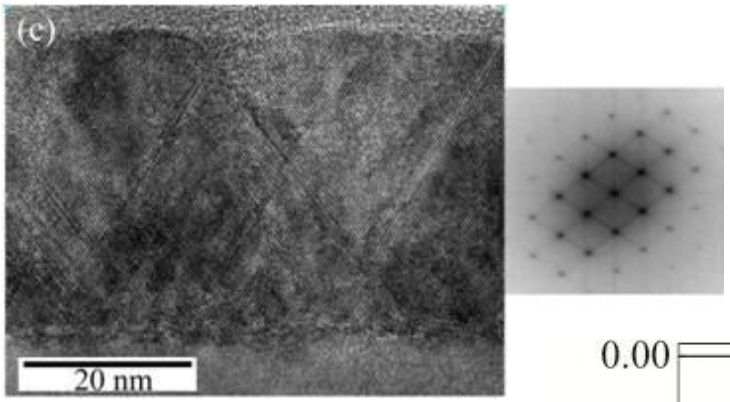


Wave functions of various spin electrons are shown with broken lines.



Spin-transfer torque magnetic random-access memory (STT-MRAM). Current flowing out of the fixed layer is spin-polarized. When it reaches the free layer the majority spins relax into lower-energy states of opposite spin, applying a torque to the free layer in the process.

Semiconductor-based spintronics: *all of the above, many others and much better*. But we need ***ferromagnetic semiconductors*** at room temperature.



The cross section and regular structure of *(In,Fe)Sb/GaAs* semiconductor layer which retains ferromagnetic properties at room temperature.

The ***hysteresis of magnetoresistance*** (MR) indicates the conservation of ferromagnetic properties up to room temperature (300 K).