

# Layered nanostructures for permanent magnet and spintronic applications

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## Abstract

What in common have the spintronic nanodevices like magnetic tunnel junctions and the permanent magnets used in wind turbines? For both applications the materials with very similar chemical compositions (Fe-Co-B) are considered. In this proposal the atomic scale models of perpendicular magnetic tunnel junction (pMTJ) with emphasis on the perpendicular magnetic anisotropy - critical for pMTJ operation - are investigated, together with spin valve based on a single monolayer, and layered nanostructures for permanent magnet applications.

The magnetic systems in a form of nanoscale layered heterostructures are modeled in computers in a form of crystallographic structures with every single atom and electron defined, and their characteristic magnetic parameters, as magnetic anisotropies, magnetization and Curie temperature, are calculated, with particular emphasis placed on magnetocrystalline, interface and shape anisotropies. This type of calculations is often referred as first principles or *ab initio*. The main theoretical part are followed by synthesis and measurements of the selected magnetic nanostructures.

The study of magnetic anisotropy of the considered magnetic layered systems contribute to development of the so-called pMTJ (perpendicular-anisotropy magnetic tunnel junctions) used in the most modern MRAM computer chips. The study on spin valve based on a single monolayer is intended to find the most simple in production spin valve, which is another example of the modern spintronic device. Finally, investigations of multilayers of hard magnetic materials lead to development of future permanent magnets for application in electric motors and transformers.