Project 4.4: Layered magnetic structures with tuneable anisotropy and Dzyaloshinskii-Moriya interaction studied by ab-initio simulations (theoretical)

Supervisor: supervisor: prof. dr hab. Andrzej Wawro; /co-supervisor: dr hab. Carmine Autieri

Institute: IFPAN

Unit: ON-3.4

WWW: http://www.ifpan.edu.pl/sdvs/pl/on3.4.html

Background:

Most of bulk materials showing magnetic ordering can be considered in terms of Heisenberg-like exchange interactions, being of electrostatic nature. The electrons of the neighbouring atoms interact each other directly, respecting Pauli exclusion principle that determines their allowed quantum states. Such materials exhibit spontaneous magnetisation in the absence of magnetic field and are called ferromagnets. A different and more complex spin alignment can be observed in ultrathin magnetic layered structures due to the presence of enhanced perpendicular magnetic anisotropy (PMA) and Dzyaloshinskii-Moriya interaction (DMI). DMI can emerge at interfaces between ferromagnetic (FM) and heavy metal (HM) slabs owing to broken mirror symmetry. Currently, the artificial layered structures with appropriate configuration are very intensively investigated as they offer wide tuning possibility of desired magnetic properties. In layered FM/HM systems desired magnetic configurations can be achieved by optimization of relation between PMA and DMI. Our group possesses a deep and enhanced experience, gained during the last twenty years, in PMA research in the such structure types, containing ultrathin Co component layers.

Aim:

The PhD student will perform relativistic ab-initio calculations using codes appropriate to study the interface effects in layered magnetic structures. We will extract microscopic effective parameters, such as anisotropy, magnetic exchange and Dzyaloshinskii-Moriya interaction and use them to elucidate the role of various mechanisms and the stability of the numerous magnetic phases. Furthermore, there will be a strong connection between the theoretical studies and experimental teams.

This project will be realized in collaboration (consortium) with the Department of Physics of Magnetism, University of Białystok (Poland).

Requirements:

MSc in physics is required. To perform the numerical simulations we will use modern supercomputers. The project requires a willingness to learn numerical skills which we will gladly help you with. Proficiency in spoken and written English is required. Prior experience in density functional theory (DFT) is highly desired but not required. Experience in experimental work will be also an advantage.

Funding:
Scholarship: grant funding of 5000 PLN per month, before subtracting obligatory employer and employee social security contributions (~15%), for 48 months.

Contact: wawro@ifpan.edu.pl, autieri@magtop.ifpan.edu.pl