Job ID: #JOB 9/2020

Job Description

Job Title: PhD student

Job Summary:

The selected applicant will participate in the realization of the OPUS-class project entitled: „Precessional magnetization switching in ferromagnetic (Ga,Mn)N layers using sub-nanosecond short electric pulses“, financed by the National Science Centre (NCN). The aim of the project is to experimentally induce precession and the reversal of the magnetization in ferromagnetic layers of dilute magnetic semiconductor (Ga,Mn)N using sub-nanosecond electrical impulses. The novelty of our approach comes from the fact that we want to employ the inverse piezoelectric effect in ferromagnetic host: (Ga,Mn)N. As we know, the switching of the magnetization direction between two stable states separated by an energy barrier is the underlying process for magnetic recording and information storage. Yet, contemporary methods of the manipulation of this content remains energetically very costly, vastly reducing, but not undermining, the commercial importance of these memories. Among a few possible solutions to overcome this large energy budget, the switching of magnetization by electric field remains as one of the most attractive and so actively researched approaches. Therefore we aim at demonstration of the repeatable precessional magnetization switching in ferromagnetic Ga$_{1-x}$Mn$_x$N layer induced by an external electric field. The driving mechanism for this process stems from the already proven ability of tuning of the strength of the single ion magnetic anisotropy of Mn ions in GaN by the inverse piezo-electric effect [1]. In these systems a voltage $V$ applied across the crystal strains it in a linear proportion, what either expands or contracts the crystal by a length, $s=V d_{33}$, where $d_{33}$ is the relevant piezoelectric coefficient. This in turn deforms the crystal field which surrounds the magnetic ions and so modifies their magnetic anisotropy. The applicant is obliged to apply to the Warsaw PhD School in Natural and BioMedical Sciences (Warsaw-4-PhD) at the Institute of Physics of the Polish Academy of Sciences in 2020. For more information please refer to the IP-PAS international PhD studies web pages at: http://www.ifpan.edu.pl/t_en_szkola.html.


Job Description:

Requirements:

• Good analytical skills
• Experience in experimental work, particularly in electric transport and magnetometry. An experience with microwaves technique documented primarily by publications and / or reference letters will be advantageous.
• Well-developed programming skills c++ and/or python.
• Good knowledge of English in speech and writing.
• The ability to work independently and to effectively cooperate and communicate with other members of the group (including those working in theory), and with external colleagues.
• The contract is expected for 36 months as full-time with 4500 PLN per month (grant funding, before obligatory employer and employee social security contributions).

The PhD student will be involved in all aspects and research tasks of the project with the main emphasis put on experimental and laboratory work, such as design, electronolithography and testing of structures, measurement and analysis of results. These will constitute the main part of the assignment. However, since we expect that the experimental data can be reproduced by theoretical modeling obtained from the Landau-Lifshitz-Gilbert equation (that describes how the magnetization direction evolves towards its new equilibrium orientation after a change of an effective magnetic field), the PhD student will be also partially involved in numerical simulations. For this purpose an already sizably advanced universal computational code based on atomistic spin model and Landau-Lifshitz-Gilbert equation [2] will be used. It is customized to be run on ever so more efficient multicore graphics processing units (GPU).


Successful candidates have to undertake studies in the Warsaw PhD School in Natural and BioMedical Sciences “Warsaw-4-PhD”, [link](http://warsaw4phd.eu/).

**Main research field:** Physics  
**Sub Research Field:** Solid state physics  
**Career Stage:** Post-graduate  
**Research Profile** ([details](#)): First Stage Researcher (R1)  
**Type of Contract:** 36 months  
**Status:** full-time  
Salary: 4500 PLN per month (grant funding, before obligatory employer and employee social security contributions).

**Contact**  
More information can be obtained from  
prof. dr hab. Maciej Sawicki (e-mail: [mikes@ifpan.edu.pl](mailto:mikes@ifpan.edu.pl))  
dr Dariusz Sztenkiel (e-mail: [sztenkiel@ifpan.edu.pl](mailto:sztenkiel@ifpan.edu.pl))

**Application details**  
**Application deadline:** 07.06.2020 Later applications may be also considered.  
**Required materials:**  
• Scientific CV
• Cover letter
• Scan of MsC diploma or equivalent (or an explanation of when one is expected)
• Academic record (for finalized semesters)
• Recommended: A recommendation letter by an academic, or their contact email.

All materials should be submitted in electronic form by application to the PhD school [http://warsaw4phd.eu/](http://warsaw4phd.eu/), choosing the project “Precessional magnetization switching in ferromagnetic (Ga,Mn)N layers using sub-nanosecond short electric pulses”