LABORATOIRE HUBERT CURIEN
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Internship

Vanadium Dioxide-Based Films for Randomizing Photonic Emission and Absorption of Integrated Circuits

Period: March to August 2024

Location: Laboratoire Hubert Curien, Université Jean Monnet (Saint-Étienne, France)

Project:

The goal is to develop a smart coating that will prevent exploiting the photonic emission and absorption from integrated circuits, effectively limiting the use of optical techniques to reverse-engineer microchips or access the stored secret data.

The semi-conductor material of transistors in an electronic circuit emits and absorbs near-infrared radiation that can be used to obtain (passive attack) or change (active attack) the state of the circuit and access stored data or its exact configuration. A thermochromic coating based on vanadium dioxide (VO_2) will be developed to alter the photonic properties of the chip owing to heat variations during the attack. VO_2 is a well-known thermochromic material turning from a transparent dielectric to an opaque metal when heated above 68°C. VO_2 films can be easily synthesized using pulsed-laser deposition and thermal annealing, and will be used as a very thin and hard-to-detect coating on electronic chips. Its critical temperature can be adapted to any range of circuit operating temperature by varying the synthesis parameters, doping, post-treatment or inducing strain.

Tailoring VO_2 optical and thermal properties will lead to new applications not only in cybersecurity - the main focus of the project - but also in the domains of smart windows, infrared imaging, thermo-switchable optical, IR and RF devices, etc.

Environment:

This internship is part of the ANR Project "VO2Random", done in collaboration with the Institut Jean Lamour (Nancy).

The intern will be part of both the Laser-Matter Interaction team (LMT) and the Secure Embedded Systems & Hardware Architectures team (SESAM) at the Laboratoire Hubert Curien. She/He will have access to all the systems allowing for the synthesis and characterization of vanadium-based materials: femtosecond lasers and vacuum chambers for pulsed-laser deposition, Rapid Thermal Annealing ovens, Scanning and Transmission electron microscopy (SEM, TEM) coupled with Energy Dispersive Spectroscopy (EDX), Atomic Force Microscopy (AFM), Raman microscopy, ellipsometry and so on. She/He can expect to be formally trained and acquire experience on most of these devices.

Requirements:

The ideal candidate should have a strong background in physics, and be in her/his second year of a master's program (or equivalent degree) specializing in photonics and/or material science. Experience with electronics and knowledge in cybersecurity is not mandatory but will be appreciated.

She/He should have good organization skills and be able to manage the synthesis and characterization of numerous samples using many different techniques. A solid scientific culture and ability to communicate and "popularize" scientific results will be essential to ensure interaction between two teams working on distinct subjects.

Prospects:

Funding for a 3-years PhD has been obtained through the VO2Random ANR project. **Should the appointed intern decide to apply, she/he will have increased chances to be selected for this PhD position.**

How to apply:

Interested applicants are invited to send their CV **before 15/12/2023**, to:

Florent Bourquard, Associate Professor: florent.bourquard@univ-st-etienne.fr

Lilian Bossuet, Professor: lilian.bossuet@univ-st-etienne.fr