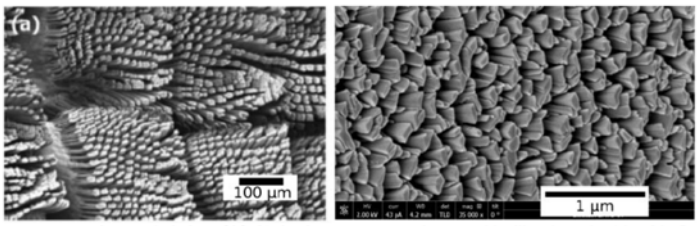
PhD Thesis - project AMFRI

Job title	Mechanical and Frictional anisotropy of nanostructured thin films deposited by GLAD technique
Job type (PhD, Post-doc, Engineer)	PhD
Contract	36 months 1600 € net/month
Qualifications (Master, Ph.D …)	Master
Job hours (full time/ part time)	Full Time
Employer	UBFC Université Bourgogne Franche-Comté
Financing Institutions	Graduate School EIPHI & Region Bourgogne Franche Comté
Host Laboratory	FEMTO-ST
URL Host Laboratory	www.femto-st.fr
Address Host Laboratory	INSTITUT FEMTO-ST – DÉPARTEMENT MECANIQUE APPLIQUÉE 24 Chemin de l'Epitaphe - 25000 BESANÇON
Job description	The 'GLancing Angle Deposition' (GLAD) technique allows an extremely precise control both the microstructure and composition of thin films. This technique consists in spraying atoms onto a substrate at a variable incidence. Thus, it is possible to produce thin films (100 nm to 1 µm thick) exhibiting original architectures at the micro and even nanometric scales. These microstructural architectures can take the form of vertical, inclined or even helical columns. This control allows to obtain films whose optical or thermoelectric properties (response level, anisotropy) can be controlled [1,2]. A thin film deposited by GLAD is therefore a microstructured and structured volume with its own mechanical properties. To our knowledge, these properties have not yet been studied in detail. Similarly to the gecko's foot, it is likely that the surface and volume structuring of GLAD films allows the development of a frictional anisotropy (see Fig. below) while ensuring a mechanical resistance compatible with tribological applications. The understanding of their mechanical and tribological behaviors is therefore the focus of the proposed study. This understanding has a direct impact on the possible applications of these films on an industrial scale, such as scratch-prone optical windows, micro-mechanisms requiring a controlled mechanical response and/or directional friction (micro-object gripping, micro-gearing).

	 *a) Surface structure of a gecko's foot [3]. B) Surface structure of a Mo thin film deposited by GLAD technique.* This exploratory project therefore has an important applicative scope in many fields and opens up the use of these thin films in a wide range of industrial applications. The PhD student will be trained on the GLAD deposition technique. The student we realize molybdenum (Mo) based thin films with different microstructures, and will carry out the deposition directly on the facilities available in the MN2S department. He/she will then try to identify: • the degradation modes under tribological stress (scratching, friction) and the existence of an anisotropy of the response of the thin films. All the experimental devices are accessible and available within the Department of Applied Mechanics, • the mechanical properties controlling the degradation modes of the films identified at the previous step. This will be done mainly using Scanning Micro-deformation Microscopy (SMM) and nano-indentation techniques, • the tribo-chemical degradation modes, in particular the role of oxidation and/or other reactions of interest on the mechanical and tribological behavior of the GLAD thin films. This last point is directly related to the previous points but also involves the physicochemistry of the surfaces of the deposits which can be characterized by various means available at the FEMTO-ST Institute, but also in partner laboratories. The contact conditions chosen (mechanical and environmental conditions) for steps 2 and 3 will be defined in accordance with the technological and application needs of our industrial contacts. Eventually, we will try to propose an optimal architecture with regard to (i) the mechanical and tribological resistance, (ii) the amplitude of the gradient of frictional anisotropy generated by the contact.
Supervisor(s)	PhD supervisor: Fabien AMIOT (CR CNRS, HDR – DMA department), fabien.amiot@femto-st.fr PhD co-supervisor: Guillaume COLAS (CR CNRS – DMA department), guillaume.colas@femto-st.fr Advisors: Nicolas MARTIN (PU ENSMM – MN2S department), Pierre-Henri CORNUAULT (MCF ENSMM, HDR – DMA department), Yves GAILLARD (MCF UFC – DMA department)
Candidate profile	Team oriented - Precision and rigor - Taste for experimental work - Ability to report on work - Ability to synthesize - Autonomy and initiative - Motivation and enthusiasm
Keywords	Key disciplines: Mechanics, Materials, Surfaces
Application deadline	15/04/2021

Application Depending on the type of position	Applicants are invited to submit their application no later than April 15th 2021 to the PhD supervisor and Co-supervisor. Application must contain the following documents: - CV - Cover letter - At least 1 reference letter