Spanske Forskere i Norge
Investigadores Españoles en Noruega

CONVENIO UCLM/SFNO 2022

PROYECTO 3

Afiliación del supervisor y Enlace a afiliación / Supervisor affiliation and Affiliation link
Full Professor, https://www.ntnu.edu/employees/nuria.espallargas

Título del Proyecto/ Project Title
The role of proteins in the friction and wear performance of biomedical alloys in hypoxia conditions

Perfil preferencial del estudiante
Materials engineering, mechanical engineering

Fechas orientativas/Available Dates
August to January (flexible) or January to June

Programa/ Detailed program of the traineeship period (aprox. 100-200 palabras)
A patient receiving a biomedical implant like a hip or knee joint will eventually reject it ov8er time due to wear and corrosion products accumulating around the implant area. The rejection process starts immediately after surgery however, it is not noticeable before the hip rejection develops into an inflammation. Inflammation is an immune reaction/response that migrate immune cells to the affected area to restore balance by removal of foreign pathogens, which practically is the emission of implant wear particles from the hip. Immune cells consume a lot of oxygen causing the inflicted area to experience local hypoxia (oxygen depletion).

The local lack of oxygen in a metal implant affects its performance and can lead to unexpected friction and wear evolution. The goal of this project is to go deeper into the friction and wear performance of biomedical alloys in hypoxia conditions, i.e. in the absence of oxygen. One very relevant part of this topic is to investigate the tribocorrosion performance of CoCrMo biomedical alloy in the absence of oxygen such as found in inflammation situations when this alloy is used as a biomedical implant. Very relevant is to study also the role of the absence of oxygen on the proteins' activity on the surface of the metal. It is well known that proteins increase the corrosion degradation of CoCrMo, however the combined role of the absence of oxygen and p8roteins in inflammatory situations is unknown. This is critical since the presence of oxygen is the driving force for any corrosion process on metals.

At the Tribology Lab we have designed a triboelectrochemical set-up to perform tests under controlled atmospheres, achieving a concentration of oxygen in the electrolyte below 10 ppb. In order to achieve an oxygen free electrolyte, nitrogen or argon gases can be used. We would like to expand this experimental set-up to be used with simulated body fluids including proteins to study for the first time and in-vitro the role of oxygen concentration in protein adsorption and its role on the friction and wear performance of CoCrMo. This project will also benefit from a combined study using Quartz Crystal Microbalance (QCM-D) and nano-friction studies once the macro-tests are performed.

Competencias a adquirir por parte del estudiante/ Knowledge, skills and competences to be acquired by the trainee at the end of the traineeship (expected Learning Outcomes) (aprox. 100 palabras)
In this project the student will acquire competences in tribology (friction, wear, lubrication). The student will also acquire knowledge in materials used in the biomedical industry. The student will also acquire training and knowledge of the most advanced tribometers and microscopy techniques.

Seguimiento/ Monitoring Plan (aprox. 50 palabras)
The student will be closely supervised by the responsible of the project and by a postdoc working in the project. Weekly meetings and follow up of the work will be performed. The student will receive the necessary training and tools to perform his/her work in our 8labs.

Evaluación/ Evaluation plan (aprox. 50 palabras)
The work performed in this Project can be presented as master thesis since it will be equivalent to 30 ECTS.

Conocimientos técnicos o experiencia requerida (si procede) / Technical knowledge or experience required (if applicable)
Language competence required: Good oral and written English skills.
It will be an advantage if the student is familiar with the field of tribology.

Especificaciones extra de la institución de acogida (si procede) / Additional specifications of the host institution (if applicable)

N/A

Disponibilidad para evaluar informes de convalidación de créditos (Si/No) / Availability to evaluate credit convalidation reports (Yes / No)
Yes

Otra información relevante / Any additional important information