

Subject Title: Space coating: numerical analysis of the mechanical properties identification using nano indentation experiments

Speciality:

<input checked="" type="checkbox"/> aeronautics/space	<input type="checkbox"/> transportation	<input type="checkbox"/> energy
<input type="checkbox"/> mechanics/metallurgy	<input type="checkbox"/> engineering	<input type="checkbox"/> SSI
		<input type="checkbox"/> other :

Kind of Work:

- R&D theoretical work / numerical modelling
- R&D theoretical work and experimental work
- R&D experimental work
- Other

Length: 5 to 6 months

Person responsible of the project Campus ENSICA Campus SUPAERO

Family Name and First Name: **Christine ESPINOSA** Function: Associate Professor
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 Lab: Department of Mechanics of Structures and Materials (DMSM)

Person co-responsible of the project Campus ENSICA Campus SUPAERO

Family Name and First Name: **Catherine MABRU** Function: Associate Professor
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 Lab: Department of Mechanics of Structures and Materials (DMSM)

Confidentiality: no yes kind of confidentiality: industrial

Number of students : 1 students students

Subject

Subject: Characterization of mechanical properties of thin coatings often uses both an experimental measurement and a numerical simulation of the force vs. indenter displacement during a nano indentation testing, in a reverse engineering methodology. Applications that are under consideration here are the characterization of thin coatings for space applications (some microns).

This project aims to use a novel approach to represent indentation, the Smooth Particle Hydrodynamics (SPH) meshless method that avoids or highly limits the previous numerical penalty. As a starting study, the descending indentation path of the indentation will be the considered loading taken into account. In a second stage unloading will be analyzed. Numerical models will be constructed with help of researchers that are already working on this project. A small course will be given on the method theory and the LS-DYNA computation code that will be used.

Pre-requisites or Bibliography:

The applicant must have a previous experience in Finite Element computation and theory, and must have already used a computation code (LS-DYNA, SAMCEF, ANSYS, RADIOSS, NASTRAN, other...).

The applicant will be given a bibliography support, and some references to consult books available at the documentation centre.

Precise objectives fixed to the student:

The first aim of the internship is to evaluate the ability and the limits of the SPH method in modelling the shape of the indentation crater during and after the displacement of the punch inside the matter that is to be characterized. Results of the simulations will be compared with data available in the literature or with experimental results lead during the internship or already available in the Department.

Implemented resources:

- Methodology: the applicant will follow a reduced class on SPH usage and will be helped all the internship long, to build up the models, run the simulations and analyse the results.
- Facilities: testing resources, numerical resources: software (LS-DYNA), computers will be lead at the disposal of the applicant with some help.
- Human: engineers, technicians, and the associate professor in charge of this subject will help the applicant if needed.

Special aspects: -

This work is part of a research collaboration between the Department of Mechanics of Structures and Materials of ISAE and CNES Toulouse Space Center.