

Post-doc Position

Design, realization and characterization of a piezoresistive force microsensor dedicated to a microforce measurement platform

- 🔗 Duration: 18 months (possibility of extension to 24 months)
- 🔗 Availability: **immediately**.
- 🔗 Topics: original microfabricated piezoresistive force sensor ;

🔗 Context: NANOROL project.

The Post-doc researcher will work in the French NANOROL project (<http://nanorol.cnrs.fr>) which is a collaborative project between FEMTO-ST Institute in Besançon and ISIR Institute in Paris. This project is focused on the general field of micro-assembly where the micromanipulation tasks (pick and place) are specifically complex. It deals with the modelling, simulation and experimental measurement of non contact and adhesion forces acting at the micrometer scale in order to improve micromanipulations and micro-assembly methods. The general aim of the project is the development of a high resolution platform in order to measure, model and simulate at the 'nanoNewton range' the interaction efforts during micromanipulation tasks. Four sub-projects are running to develop the NANOROL platform:

- 🔗 SP1-MODELING; modelling and simulation of small objects behaviour,
- 🔗 SP2-SENSING; **study and experimentation of a force measurement systems,**
- 🔗 SP3-POSITIONING; study and experimentation of a highly accurate micro/nanorobot to position micro-objects during measurement,
- 🔗 SP4-PLATFORM; integration and management of the platform.

The post-doc position is directly linked to the sub-project 2 **which consists in developing and improving microforce sensors.**

Objectives:

The effort range that is necessary to measure for the NANOROL project is extremely large, typically from some nanoNewton to one milliNewton. In order to perform this task an atomic force microscope (AFM) is currently integrated in the experimental platform. Different AFM cantilevers are selected depending on the effort level that the experiments require. A problem still remains in the case of measurements where the cantilever and the manipulated object are in contact. It appears coupling effects that generate important measurement errors.

In this context, the Post-doc researcher will develop alternative microstructures in order to insure better accuracy of contact force measurement. The adequacy of these

solutions to nanotribology applications has also to be taken into account. The following topics will be addressed in this research:

🌀 Design of microfabricated silicon microsensors based on piezoresistive effect:

The goal is first to design optimised structures in order to measure forces from 100 μN to 1mN with the best possible resolution and secondly to obtain uncoupled structures for two degrees of freedom microsensors (*i.e.* two axis measurements). The latter design will be useful in order to apply large preloads on micro-objects and simultaneously to measure force friction (for nanotribology applications). The Post-doc researcher will take in charge this mechanical study and will simulate results using Comsol Multiphysics.

🌀 Sensor microfabrication:

The post-doc researcher will fabricate one and two dof sensor prototypes using the microfabrication facilities of FEMTO-ST. Then, an experience in clean-room microtechnologies is highly recommended. Moreover, according to the complexity of the design, some technological steps could also be performed in other French microfabrication technology centres.

🌀 Characterization, calibration and exploitation of the sensors:

The post-doc researcher will take in charge the characterization set-up in order to study the mechanical and electrical behaviour of the prototypes. The calibration strategy will be also considered and the prototypes will be tested on the NANOROL platform.

The post-doc researcher will work in direct collaboration with a research engineer involved in microgripping tools and sensors for micromanipulation. He (she) will also work with other researchers and engineers involved in the NANOROL project.

🌀 **Location: FEMTO-ST Institute (Besançon, France).**

FEMTO-ST is a French public research institute (notably granted by CNRS) involved in several fields of Engineering Sciences (www.femto-st.fr/en). Among the 500 employees including 270 permanent positions (175 researchers, professors or assistant-professors and 95 engineers, technicians and administrative staff), about 180 doctorate students receive a high-level training in scientific research. Within FEMTO-ST, research in Engineering Sciences has long been influenced by the regional manufacturing tradition of microtechniques. FEMTO-ST runs a microfabrication technology centre, which is recognized nation-wide, mixing technology from microelectronics and micromechanics. The Post-doc position is available in the *Automatic Control and Micromechatronic Systems* Department (AS2M Dpt) where the micromechatronics and microrobotics research group is working on robotic micro-assembly.

🌀 **Candidates and applications.**

Expertise on one or more of the following topics is required: MEMS design, clean-room microtechnologies and microfabrication, piezoresistive sensors, MEMS characterization.

Applicants should send a C.V. and journal publications in pdf format by email to joel.agnus@ens2m.fr.