

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: LMCE Laboratoire Matière en Conditions Extrêmes
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Internship location:
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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: CEA

Nucleation kinetics of noble gases at different compression rates.

The Diamond Anvil Cell equipped with piezoelectric actuators (d-DAC) is an innovative device that enables the generation of dynamic compressions and decompressions over a wide range of pressure-change rates. The d-DAC thus makes it possible to perform finely controlled dynamic loadings, with (de)compression rates spanning several orders of magnitude along isothermal paths. This opens the way to the construction of reference databases for the validation of microscopic mechanisms. Moreover, compression and decompression rates can be regarded as equivalent to ultrafast heating or cooling rates of the sample, offering the possibility to explore, in a highly controlled manner, certain phenomena still debated in the literature, such as the maximum stability of a solid beyond its melting point.

We have developed a d-DAC that delivers state-of-the-art performance. A set of diagnostics provides a particularly comprehensive time-resolved characterization of the sample properties within the d-DAC. In our laboratory, pressure measurements by luminescence, visual observation, and Raman spectroscopy are now fully operational. Infrared absorption measurements are currently under validation, at the proof-of-concept stage. X-ray diffraction experiments are routinely carried out on the ID09 beamline at the ESRF. The d-DAC can also be coupled with an internal resistive heating device, enabling (de)compressions along different isotherms and thereby extending the [P, T] exploration domain of the apparatus.

The objective of this internship is to exploit the new possibilities offered by the d-DAC to demonstrate novel phenomena or to gain a detailed understanding of certain effects discussed in the literature, by carrying out ultrafast pressure variations. Specifically, it will consist in studying the nucleation kinetics of noble gases (Ar, Ne, Kr) as a function of the compression rate, and comparing the results with recent measurements performed at XFEL in cryogenic jets.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	NO	Theoretical Physics:	NO