Univ. Grenoble Alpes
Université de l'innovation

Postdoctoral position in Materials Science
3D structural imaging of heterogeneous materials

JOB PROFILE:

Functional materials, whether synthetic, natural or from cultural heritage are often heterogeneous. Characterizing their 3 dimensional structure, often quite complex, can be very challenging. Indeed, X-ray diffraction, one of the prime structural methods, suffers from a relatively poor detection limit and difficulties to handle samples with strongly heterogeneous microstructures. Many experimental methods on synchrotron radiation beamlines were developed by the materials science community to overcome this limitation. Among them, diffraction computed tomography has recently emerged, which combines in the same experiment X-ray diffraction and tomography measurements. This method is based on structural selectivity and is independent of the degree of crystallinity of the various phases in the sample. Recent successful experiments [Schroer *et al., Appl. Phys. Lett.* 2008, Bleuet *et al., Nat Mater*. 2008, De Nolf *et al.*, *Surf. Interface Anal* 2010, Artioli *et al.*, *Anal. Bioanal. Chem.* 2010, Palancher *et al.*, *J. Appl. Crystallogr.* 2011, Alvarez *et al.*, *J. Appl. Crystallogr.* 2011, Cersoy *et al.*, *J. Appl. Crystallogr.* 2016] have demonstrated the possibility to i) detect amorphous/nanocrystalline compounds in a phase mixture, ii) extract diffraction patterns from the minor phases, and iii) obtain 3D mapping of the phases present in the sample. Such a diffraction tomography experiment can be carried out simultaneously with X-ray fluorescence, Compton and absorption tomographies, enabling a multimodal analysis of prime importance in materials science, chemistry, geology, environmental science, medical science, paleontology and cultural heritage.

The objective of this postdoctoral project is to apply the diffraction computed tomography method to the study of cultural heritage materials in the framework of the interdisciplinary project PATRIMALP (Cross Disciplinary Program, IDEX, Université Grenoble Alpes). We will focus on ancient polychrome stratigraphies found on various substrates (rock for Neolithic paints and wood for medieval statues). A better knowledge of the 3-dimensional structure of these artefacts will shed new light on ancient manufacturing processes, materials' provenance and conservation strategy. The Postdoctoral researcher will be in charge of the following tasks:

- Improvement of 2D detectors data treatment with the development of specific analysis tools for on-line data reconstruction;
- Optimization of the experimental setup to build a dedicated sample holder for the ESRF CRG-BM02 beamline. It should allow automatic position references and multi-instrument experiments.
- Application of this methodology to cultural heritage samples (unique, precious, and available in small quantity).

In order to obtain a multiscale imaging of the sample, different X-ray beam sizes will be used and these developments will be hence conducted between the ESRF CRG-BM02 beamline and a recently developed lab setup [Cersoy *et al.* 2015]. In particular, the use of a larger X-ray beam (sub-millimetric) will allow us mapping bigger samples (or objects) and broadening the scope of application of the method with the establishment of tailor-made analysis tool. The Postdoctoral researcher will be located at the ESRF, working between a synchrotron beamline and an X-ray lab source (respectively BM02 and the Neel Institute), in collaboration with the ESRF ID22 beamline. To improve the data analysis part, collaborations have been established with the ESRF SciSoft group (pyFAI library). The researcher could rely on existing codes to build a coherent analysis tool.

Further information may be obtained from Nils Blanc (tel.: +33 (0)4 76 88 21 88, email: nils.blanc@esrf.fr).

Required languages*: English, French*

TYPE of CONTRACT: temporary (1 year contract with the Université Grenoble Alpes. Gross salary ~2500€/month).
OFFER STARTING DATE: 23th April
APPLICATION DEADLINE: 16th March
ELIGIBILITY CRITERIA:

Applicants must hold a PhD degree (or be about to earn one) or have a University degree equivalent to a European PhD (8-year duration) in physics, materials science, chemistry, or closely related science. A background in X-ray diffraction techniques and basic programming (python) are desirable.

Applicants will have to send **an application letter** in English to nils.blanc@esrf.fr and pauline.martinetto@neel.cnrs.fr and attach:
- Their last diploma
- Their CV
- Letters of recommendation are welcome.

SELECTION PROCEDURE

Application deadline: **16th March 2018** at 18h00 (CET)
Applications will be evaluated through a three-step process:

1. Eligibility check of applications, mid-March 2018
2. 1st round of selection: the applications will be evaluated by a Review Panel and a short list of candidates will be selected by March 23, 2018.
3. 2nd round of selection: shortlisted candidates will be invited for an interview session in Grenoble, and final selection should be announced by April 9, 2018.