Postdoctoral position for the optimisation of a quantum grade diamond synthesis process for the development of spin-based solid state quantum processors (H/F)

Duration 12 mois

Context:

This post-doctoral position is proposed in the framework of a 36-month European Quantera project. The MAESTRO (Mastering Technologies for Scalable Spin-based Solid-State Quantum processors) project aims to the development of technologies to design the first technological bricks for quantum computers. In particular, MAESTRO proposes a new approach to develop solid-state qubit architectures based on NV centres in diamond that can operate at room temperature. Recent efforts in this consortium have shown the possibility of quasi-deterministically positioning qubits based on NV centres at a distance of about 10-40 nm, allowing the realisation of two-qubit gates based on magnetic dipole-dipole coupling. The electrical spin reading method, also developed over the last 1-2 years by members of the same consortium, allows the reading of these single spin qubits, which solves the main scaling constraint (increasing the number of addressable Qubits) of this diamond quantum material. The central objective of this project is to overcome the technological barriers to scaling up this quantum material by optimising the deterministic manufacturing processes of NV qubits leading to an improvement of the production yield. In the same time, the development of a selective electrical readout of qubits, applied to a nanoscale array of intricate qubits, will allow the development of a quantum processor platform that in the future could lead to the development of marketable industrial applications.

Post-doc tasks:

The post-doctoral fellow will be hired by the LSPM (Laboratoire des Sciences des Procédés et des Matériaux), in which he will be responsible for optimising the diamond growth process used as a platform for deterministic implantation of NV centres. He will also participate to the development of an experimental setup allowing characterizing optical properties of NV centres (T1, T2 et T2* measurements). The deposition processes that will be used are chemical vapour deposition processes assisted by microwave plasma, which have now been developed within the LSPM for some twenty years and in which our expertise is internationally recognised, in particular for the production of quantum grade diamond films. Two axes will be carried out in parallel. The first will be more specifically dedicated to the study of defects incorporation during the growth, the objective being to determine the growth conditions limiting as much as possible their presence, which is very well known to lead to a strong impact on quantum qualities of the material. The second will consist in optimising the growth conditions in order to produce diamond films with a controlled ^{12}C isotopic concentration. During this work, the films produced will be characterised in order to determine their quantum properties for the targeted application (measurement of the NV concentrations, strain and coherence times). These characterizations will be done within the LSPM thanks to the developed experimental optical setup or in collaboration with the members of the MAESTRO consortium.

Profile:

We are looking for candidates with a background in material sciences, optics, experimental physics or equivalent degree with a completed PhD degree. Very good knowledge in the field of materials, their synthesis and their characterization is expected. Experience in the field of colour centres characterization is also desirable. The post-doc would present high degree of commitment, self-reliant working, ability to handle stress, team spirit, flexibility, reliability and problem-solving competence. Good English skills (spoken and written) are required, as well as experience in writing scientific reports and publications.

Complementary informations:

Funding : Grant ANR-22-QA1-0003-07, 12 months full time (Salary according to experience, 2890 € gross per month). The contract may be extended for 10 extra months.

Starting date : January 2023.

Working place : Laboratoire des Sciences des Procédés et des Matériaux, Université Paris 13, 99 avenue JB Clément, 93430 Villetaneuse (https://www.lspm.cnrs.fr/).

Application through the CNRS website following the link https://emploi.cnrs.fr/Offres/CDD/UPR3407-JOCACH-003/Default.aspxx