

## Post doc proposal

### Development of performed sapphire through crystallization from melt

Because of its high melting temperature (2050°C), its chemical resistivity and its wide range of transparency (0.24 - 4µm), sapphire (Al<sub>2</sub>O<sub>3</sub>) is used in a wide field of application. At room temperature, sapphire is used as an insulating dielectric material but at cryogenic temperatures it is a good thermal conductor. The transparency and high melting point of sapphire make it an attractive material for infrared and ultra-violet windows. It is a material often used for laser applications when it is doped with titanium (Ti<sup>3+</sup>) or chromium (Cr<sup>3+</sup>) oxide. Finally, sapphire is present in jewelry because it is possible to obtain many colors for synthetic stones. The main sapphire production techniques are: Verneuil, Czochralski, Kyropoulos, Stepanov (EFG), HEM (heat exchanger method), micro-pulling down (µ-PD). The key factors for the crystal growth of a performing high purity sapphire are the selection of the starting raw materials and the control of the process. Whatever the crystal growth technique, defects (pores, bubbles, dislocations, inclusions, mosaic, gaps, scattering, inter-growth, streaks) are very often observed in sapphire crystals. Despite the improvement of crystal pulling processes, it is now very difficult to grow sapphire crystals defects free. Sapphire has a very special defect, in the form of gas microbubbles, with diameters varying from one micrometer to a few tens of micrometers. This type of defect has a bad influence on the properties and the material uses. The microbubbles affect the optical properties by decreasing the transparency as well as the production yield.

The Auvergne Rhône Alpes region is an essential leader in the crystal growth of performed sapphires thanks to a privileged environment combining research (Institut Lumière Matière, UCB Lyon1, UMR 5306 CNRS) and production (RSA le Rubis, 38). Within the framework of a Labcom (SaphirLab) associating the ILM (Luminescence team, <http://ilm.univ-lyon1.fr>) with RSA Le Rubis (<http://alumine-rsa.com>) to improve the quality and the properties of sapphires to meet the next great needs of technological sapphire for optics and jewelry, we are recruiting a postdoc to carry out work on the crystallization and characterization of sapphire through the study of :

- \* Crystal growth conditions imposed by the processes implemented at iLM and RSA le Rubis,
- \* the presence of impurities and defects in the starting raw material likely to affect the crystal growth, the coloring and the macroscopic and microscopic properties of the crystal.
- \* Possible ways for controlling pulling processes likely to improve the optical performance and the physico-chemical properties of the crystal.

These various studies will be carried out in particular on the Czochralsky process in a modified version for which the geometry and the materials constituting the thermal zone have been completely redefined.

We are looking for a motivated postdoc candidate to work on sapphire crystallization issues as well as optical and physico-chemical characterizations at the Lumière Matière Institute (luminescence team). The employed post- will therefore, as part of this project, have to grow sapphire crystals, identify the origin of defects and improve performance (transmission, color, doping). It will also be able to benefit from collaborations with the company RSA Le Rubis, industrial partner of the project. The post doc may be required to travel to different sites in the Auvergne-Rhône-Alpes region.

#### Required Skills :

- Materials science (good knowledge)
- Crystal growth
- Techniques of characterization of crystalline materials including optics (in-depth knowledge)
- Define and implement a protocol for the development, preparation and characterization, shaping and processing of materials

**Main tasks and responsibilities:**

- Crystal growth and characterization.
- Execution, analysis, report preparation of results concerning the crystallization of sapphire.
- Characterization of colored sapphires.
- Analysis and interpretation of data and contribution to the planning and execution of the various experimental campaigns and exchanges with the RSA partner

**We offer :**

As a postdoc you will have access to:

- State-of-the-art facilities, including crystal pulling facilities at ILM and RSA
- Enriching career development environment.
- Innovative and dynamic atmosphere
- Competitive salary (depending on experience)

**Start date :**

Flexible, depending on candidate (but before March 2023)

**Type of job:**

Full time, CDD (renewable)

**Contact :**

Dr. K. Lebbou (kheirreddine.lebbou@univ-lyon1.fr), ILM UMR 5306 CNRS, UCB Lyon1.

Dr. S. Labor (serge.labor@rubisrsa.com), RSA Le Rubis.