

## *P2IO Report*

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### *1. Project goals (approx. 15 lines)*

In order to improve RF performances of the SRF cavities, an alternative based on multilayer assembly is investigated (NbN/AlN). For this purpose, the MBE technique has been chosen as coating process because of the high quality of produced layers. For the sample production based on oxide and nitride layers, a plasma source is required for the systems NbN/AlN and NbAl/Al<sub>2</sub>O<sub>3</sub>. The first step is to upgrade MBE setup with ECR source at CSNSM laboratory. The second step deals with the production of NbN/AlN samples and optimization of coating parameters (temperature, velocity, pressure etc). Finally, as a last step, these samples will be characterized with magnetometer at Irfu and RF cavity at IPN laboratory. Unfortunately, the supplier had not filled all specifications and we have cancelled the purchase. In parallel, we contacted collaborator from IN2P3 in order to supply an ECR source to produce the plasma required for nitriding and oxidation process of the niobium and Aluminium layers. The work is well progressing and we could start the work on MBE chamber during March. Helped of the support of post-doctoral position funded by P2IO, the experimental set-up at CEA and CSNSM are improved until the ECR source delivery. Magnetometry and RF characterizations are scheduled during first half of this year.

### *2. Description of work achieved (approx. 2 pages)*

During the 1th year of my P2IO post-doctoral position with the team, we have performed 3 RF test on the TE011 cavity at the "cryodrome" of the ipn laboratory. Samples were multilayer assemblies of NbN/MgO on bulk niobium and produced by J.C. Villegier (Inac, Grenoble). We get some good and promising results with these samples which give the opportunity to give an oral contribution to SRF2013 conference.

In parallel, we improve the design, the power and the capacity in ultra-high vacuum of the ECR RF source for the Molecular beam epitaxy of the CSNSM. I remind you that work is coming from the difficulty to find a system adapted for our set up in commercial issue.

At the CEA Irfu, I started to improve, with Claire Antoine, the magnetometer, but here it was planned to continue this work on the second years of the post-doctoral position.

This work was a really good experience, and the development of the RF source was valued in the formation, from the drawing by computer for design study to the mechanical elaboration, the commissioning and the first test. The source still need some hours of work but it close to be efficient. Indeed, we fell that RF source will be a great tools to grow the new multilayer sample for a better understanding of the future evolution materials for the RF cavity.

### *3. Publications*

C. Baumier et al., MULTILAYERS ACTIVITIES AT SACLAY / ORSAY, proceedings of SRF2013, Paris

<http://hal.archives-ouvertes.fr/in2p3-00868927/>

<http://ipnweb.in2p3.fr/srf2013/papers/weioc02.pdf>

### *4. Relevance of the project within P2IO (approx. 15 lines)*

This position was the opportunity to link activities on SRF multilayer between the involved laboratories. It is a transversal thematic dealing with superconductors, RF cavities, plasma sources and instrumentation. In this context, P2IO is an efficient tool to support small R&D project. Each laboratory is expert in their field of physics but this kind of research is difficult to be supported by only a unique laboratory. In this context, this project put the basis of the R&D for the investigations on new materials dedicated to the SRF developments

***5. For R&D only: possible valorization of the project***

If promising results are confirmed, the impact on SRF cavities development could be important. The accelerating gradient could be improved by a factor 2 and/or the power consumption could be divided by a factor 2. For the future machine like the International Linear Collider, the cost of the construction and the exploitation could be roughly decreased.

***6. For R&D only: expenses sharing***

***7. For end of contract post-docs: position after P2IO***

I get the opportunity to work during 18 month on the JANNuS platform, so I took it, since november 2013. So i quit the P2IO program after 14 months in end of october 2013.