Minutes of 140th Collimation Upgrade Specification Meeting

Participants: O. Aberle (OA), C. Accettura (CA), A. Bertarelli (AB), M. Calviani (MC), F. Carra (FCar), F. Caspers (FCas), M. D’Andrea (MDA) (scientific secretary), A. Fomin (AF), R. Franqueira Ximenes (RFX), J. Guardia Valenzuela (JGV), P.D. Hermes (PDH), I. Lamas Garcia (ILG), A. Lechner (AL), J. Molson (JM), F.X. Nuiry (FXN), S. Redaelli (SR) (chairman), N. Solieri (NS), F. Van der Veken (FV), A. Waets (AW), M. Zerlauth (MZ).

Indico link

Actions from this meeting

- Discuss a proposal for the optional activities to be performed on the irradiated samples (NS, CA, FCar).

1 Introduction and minutes of the last meetings (S. Redaelli)

SR briefly showed the minutes of [ColUSM #139](https://example.com), which was dedicated to the functional specification for the HEL in preparation of the [HL-LHC Hollow Electron Lens (production) kick-off meeting](https://example.com). A few actions were identified and the follow up is currently ongoing.

2 CERN2 BLIP capsule inspection update (N. Solieri) [slides]

Summary of the presentation

NS gave a brief introduction on the BLIP setup, where material irradiation is carried out in the framework of the RaDIATE Collaboration. FLUKA simulations are used to define the scope of an irradiation run and the target assembly. The capsules containing the material specimens are then fabricated and shipped to BNL for installation in the beamline. The cooldown after irradiation is of the order of a year.

The irradiation of the CERN2 capsule was carried out between January and March 2018. The irradiation parameters were chosen to be in line with what is expected for MoGr primary collimators during operations at the LHC. Even though the schedule was respected since the arrival of the capsule at Framatome, the whole test was delayed by more than one year due to the COVID pandemic.

High-precision CNC milling was employed by Framatome to open the capsule. Compared to the PNNL opening setup, this procedure is more reliable and reduces stresses on the specimens, which were identified as possible cause of damage to the samples in past experiments. NS showed a [video](https://example.com) detailing the opening procedure. All specimens were extracted and they were all in great conditions except for two Si specimens, which was already expected given their fragility.

The visual inspection of the Mo-coated MoGr samples was carried out by taking pictures at high magnifications with an optical microscope. No macroscopic damage is visible in any of the specimens. A visual inspection of an unirradiated specimen was also done to allow a meaningful comparison. An assessment of asperities on the sample is not possible with this setup because of the small depth of field of the optical microscope. SEM inspection of the coating is within the budget of optional activities, and a sample of the results was offered free of charge by Framatome. This will be submitted to WP5 to assess interest in this option.
difference were observed for the CFC specimens either, and the acquisition of pictures of the unirradiated specimen is currently underway. Next steps include adhesion tests to evaluate the adherence of the Mo coating to the substrate after irradiation. The procedure will be tested on a spare unirradiated Mo-coated MoGr specimen, and the results will be used for the comparison with the irradiated samples. A potential offset of the beam impact position on the capsule was observed and needs to be taken into account when deciding which specimen to use for the adhesion test.

NS concluded by giving an overview of the baseline and optional activities included in the contract with Framatome.

Discussion

• SR commented that the agreement with Framatome on the setup was reached a bit late with respect to the irradiation time, and asked what would be the minimum time required to ship the irradiated samples to the facilities had this delay been avoided. NS replied that, with regards to this specific case, the shipment time was severely affected by the pandemic. However, in principle the timeline depends on the activation of the specific material. For example, a shorter timeline is expected for the CERN3 capsule, which only contains graphitic materials.

• FXN asked how the metal particles originating from the milling process are dealt with. NS replied that they are cleaned off with a brush between each step of the opening procedure. MC added that a complete decontamination of the hot cell is ran after each use.

• FXN asked what the residual dose rate of the capsule was. MC replied that it was about 200 mSv.

• CA asked if the sample is taken out of the capsule with a magnet. NS replied that vacuum tweezers are used.

• SR asked clarification on the brownish color that can be seen in the pictures of the specimens. NS replied that this is due to the lighting conditions in which the pictures were taken. The same conditions were applied to both the irradiated and unirradiated specimens to allow a direct comparison.

• AB commented that the coloration seen in the pictures of the capsule may indicate an excessive temperature increase, and asked if the observations are consistent with expectations. NS replied that the analysis showed that it is highly unlikely that the cooling system reached burn-out conditions. However, this matter is being investigated and other possibilities are being explored.

• SR commented that some activities were kept as an option in order to see if the samples were intact, which turned out to be the case. Furthermore, some of these activities, such as the adhesion test, are destructive for the sample, so they need to be carefully timed. NS added that the adhesion test is going to be carried out only on two out of the four specimens, so the others can be used for other activities. FCar commented that if they are useful, all the non-destructive measurements could be performed on all samples before moving on to the destructive ones. CA added that the microstructural investigation involves the milling of a very small area, so it is only locally destructive. Furthermore, the area used for the adhesion test is smaller than the whole sample, leaving the outer surface...
untouched and available for other tests. SR concluded that a proposal can be discussed and prepared offline.

- SR commented that these results were requested to be reported at the TCC, but it could be more practical to wait for the outcome of the adhesion tests as well. MZ agreed.

3 Carbide-Carbon materials within the new IFAST project (F. Carra) [slides]

Summary of the presentation

FCar presented an overview of the IFAST project, a collection of joint R&D activities with industry and strategy groups to develop ideas and technologies for the next generation of particle accelerators. In particular, WP4 managed innovation and new materials for accelerators and commercial applications.

Task 4.4 is dedicated to large scale Carbide-Carbon materials for multipurpose applications, with CERN and Nanoker as partners and a duration of four years. This task aims at increasing the size of the CCM plates that can be produced, while reducing the cost of the finished components. Nanoker will cover the production side, while CERN will take care of the acceptance tests of the upscaled plates. Possibly cheaper CCM alternatives to MoGr will also be investigated.

A summary of R&D on alternative CCM is due in one year. The milestone on the feasibility of the production of large-size CCM plates is due in two years, but if successful it is expected to be fulfilled in less time, since it would also be useful for the production of collimator materials.

Discussion

- FXN asked if there are also technical objectives in terms of material performance. FCar replied that the plan is to provide Nanoker with technical specifications based on collimator materials, and the company will have to achieve the goal dimensions while respecting these specifications.