

Minutes of the 18th meeting of the SPS Upgrade Study Team on 9 September 2008

Present: F. Caspers, P. Chiggiato, R. Garoby, E. Mahner, E. Metral, G. Rumolo, E. Shaposhnikova, M. Taborelli, C. Yin Vallgren

• Experience with production of coatings with low SEY, effects of venting and scrubbing - N. Hilleret

The SEY of technical materials is very different from pure metals due to oxidation and contamination of the external layer. After initial treatment (conditioning) followed by air exposure the second conditioning takes much less time due to the reduced depth of the contaminated layer. A thin layer of condensed water on the surface increases the SEY proportionally to its thickness up to ~ 100 monolayers (saturation afterwards).

The SEY of insulators ($\delta_{max} \sim 2.5-10$) after a 250 deg bake out is on average significantly higher than the SEY of metals ($\delta_{max} \sim 2-3.5$). The more pure the insulator the higher is the SEY.

Remedies are based on changing the surface composition and topography (black layers) and the dose effect (e-bombardment). The first and the last are more sensitive to air exposure and need re-baking and reconditioning. For the processed copper surface ($\sim 1 \mu\text{m}$ roughness) the measured SEY was as low as 0.5, but the surface is very fragile and creates a dust. With bombardment the SEY of SS, Nb and Cu baked to 300 deg can be reduced to 1. The TiN coating is not as good as one thinks. It is the rough structure which is responsible for the low SEY (1.55 as received).

The SNS vacuum chamber is fully coated by TiN and they already have problems with e-cloud (as was reported at recent HB2008 workshop in Nashville).

With the SPS constraints (no baking out) the recommendation is to look for a solution based on a rough surface (there is a lot of experience with black copper in microelectronics).

• Progress report on coatings - M. Taborelli

The measurements of the SS sample extracted from the C-magnet in the SPS clearly show a 40 mm wide region conditioned to a SEY of 1.5 (went up to 1.7 after one hour of air exposure). Outside this region the SEY is around 2.0 (the SEY of SS is 2.5). It looks as if the C-magnet was switched on only during the scrubbing run and MDs. The measured concentration of Carbon is higher in the region with lower SEY. It is not completely clear where this Carbon comes from. A sample with a thin film of an amorphous Carbon will be installed next instead of SS.

The measurements of e-cloud signals during the last MD (12.08.08) showed only very small conditioning of Carbon and SS liners due to the low accumulated dose. The signal from NEG was even growing, probably due to bad vacuum caused by Carbon sample being installed after 15 days of air exposure or kapton foil also exposed to the air. No ecloud effects have been recorded in this liner after 2 weeks exposure to the air. The SEY measured before installation was 1.25.

The effect of the dose received during each measurement on ageing of the coating is now under investigation and the results will be reported at the next meeting. This is a very important issue due to regime of air exposure of the SPS vacuum chamber during shutdown followed by conditioning

during the beam run for the SPS vacuum chamber. For the measurements during the next MD it is proposed to re-install the irradiated (during previous MD) Carbon liner after venting after venting

A possible design of the coating system for the SPS magnets was presented. This is based on 4 C-bars inside 3 rolling devices which can be inserted inside the magnet. The complete system will have the length of the magnet (to increase the coating rate). The side walls will not be coated. It takes 24 h to make a 100 nm layer. At the beginning of process the quality of coating is not so good, some minimum critical thickness being necessary to have the desired effect. It is planned to use a dipole magnetic field during the coating process (a magnetic field perpendicular to the electric one is needed). The design of coating system will be completed at the end of September. One month is required for manufacturing. Then the first test on the spare SPS dipole can be performed.

In case of successful tests it was proposed to coat 4-5 SPS magnets during the next shutdown. The microwave diagnostics can be used for e-cloud detection. This requires a careful calibration already done with beam this year.

The status of enamel electrodes in the SPS as another potential mitigation technique should be reviewed. The necessity of continuing to develop a possible engineering solution was emphasised.

- The next meeting will be on **14 October 2008** at 15:30 in the JBA room (bld. 864).

Agenda:

Coating of the SPS magnets: logistics - J. Bauche

Progress report on coatings and grooves - M. Taborelli

Progress report on enamel electrodes in the SPS and PS - F. Caspers

Elena Shaposhnikova, 16.08.2008