SPS dipole prototype coatings

Scope

- Design and built up
- The test runs
- Surface treatment
- Coating of the dipoles
- Summary of good & bad
- Conclusions

SPS-U meeting 2009-03-24
SPS dipole prototype coatings

Design and built-up

• August 2008: decision to coat MBA dipoles. Start studies for a coating system.
• September 2008: preliminary drawings. The design office suspend the work for three weeks due to an “urgent job”.

Diagram of SPS dipole prototype coatings.
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- January 2009: mount system (assembling bench&vacuum)
- February 2009: adapt electrodes. Start tests and coatings.
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- January 2009: mount system (assembling bench&vacuum)
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- March 2009: installation of the three dipoles
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4 test runs in liner

Main difficulties:

- Plasma unstable => run at high pressure (3.5x10^{-1} mbar)
  *non uniform magnetic field at extremities*
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  current leaks => change to ceramic spacers (7 mm)

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• During the 4 runs several modifications were introduced. Anodes configuration, isolation, geometry at extremities, thermocouples, etc.

**The possible modifications regarding the time available...**

• After the 4th run no more time for tests => COAT DIPOLES
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Coating of the three dipoles

Surface treatment:

• Control before surface treatment: hydrocarbons and silicon contamination.

• Procedure:
  1. Brush with acetone
  2. Rinse with demineralized water
  3. “lessive” Galvex (for Silicon contaminations)
  4. “lessive” P3 Almeco (for hydrocarbons)
  5. Rinse with demineralized water
  6. Dry by air flow

• Results: ok for silicon; but remain traces of hydrocarbons

“Les résultats ne sont pas brillant, forte présence de particules métalliques et de produit hydrocarbonés (sans surprise). Par contre, présence de produits silicones...”

Report N° VSC-CSA : X-02/01.09 by B. Teissandier
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- Results: ok for silicon; but remain traces of hydrocarbons
- The mysterious “white spots” are not removed by the surface treatment.

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Coating:

• Parameters:
  - Pressure between $3.0 \times 10^{-1}$ and $3.9 \times 10^{-1}$ mbar
  - Power $\sim 2$ kW
  - Voltage $\sim 900$ V
  - Temperature on the side of the chamber $\sim 120$ °C

• Thickness: the same non uniformity of the test runs:
  $\sim 200$ nm at the center, $\sim 1500$ nm near the cathodes.

• Endoscopy after coating only possible in MB096: no evidence of peel-off.

• Storage after coating: 1.2 bar of N$_2$

• SEY after coating = 1.0

• SEY just before pump down in the tunnel = 1.0

• During installation in the tunnel **PEEL-OFF** observed in MB085! (only $\sim 1$ cm$^2$... but always scaring!)
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Good&Bad: *the coating itself*

**BAD**
- Too non uniform thickness
- Not all the length is coated (95%)

**GOOD**
- SEY around 1
- Ageing (... so far...)

**Good&Bad: the coating process**

**BAD**
- Plasma quite unstable! (not reliable)
- Isolation system need to be changed every run
- Thermal deformation of the anodes
- Deposition time too long (34 hours)
- Wheels sliding, not rolling! (dusty)
- Temperature monitoring not allows displacement of the electrodes

**GOOD**
- Fast mounting/dismounting (if not necessary to change isolation)
- Easy to control the coating pressure
- Potential for a large scale production.

*But the electrodes have to be modified*
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Modifications

• drive the plasma independently at the extremities => *increase stability, decrease pressure, improve thickness profile and adhesion, decrease coating time.*

• Shield the bottom and top of the cathodes => *increase stability, improve thickness profile and adhesion.*

• Use ceramic screws for the cathodes supports => *faster mounting/dismounting.*

• Introduce stainless steel plate between the back of the cathode and the ceramic isolation => *avoid current leaks due to graphite “dust”, improve reliability.*

• Modify the anodes system to avoid thermal deformation => *increase stability, improve thickness profile and adhesion.*

• Decrease distance between cathodes? (40mm) => *improve thickness profile and adhesion, decrease coating time, decrease outgassing of the chamber, allow higher power?*

• Change the temperature monitoring system => *compatible with the displacement of the electrodes.*
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Conclusions

• The system is not so bad... but it is not good enough!... Yet.

• Good SEY and ageing but the peel-off observed with the dipoles already in the tunnel is scaring.

• Modifications towards thickness uniformity, stability of the discharge and reliability of the electrodes isolation

• Re-think surface treatment

• Start studying the piling-up of coating systems?

• Prepare liners to be coated inside the dipoles and tested in the SPS?

First test run on the 10th February, dipoles installed the 10th March.

It was intense, stressing, but very pleasant.