Summary of Working Group II

Chamber Coating and Treatment

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Chamber Coating

- TiN
- NEG
- Others

Chamber Treatment

- Baking, Vacuum Firing
- Cleaning

Chamber Coating – TiN

Goal: To reduce SEY

Impurity and coating pressure is critical to SEY

BNL/SNS Coating @ 5 mTorr ⇒SEY 1.5-1.8 due to rougher surface

BNL/SNS Coating @ 1.5 mTorr ⇒ SEY > 1.9 due to smooth surface

SEY of St St ~ 2.2

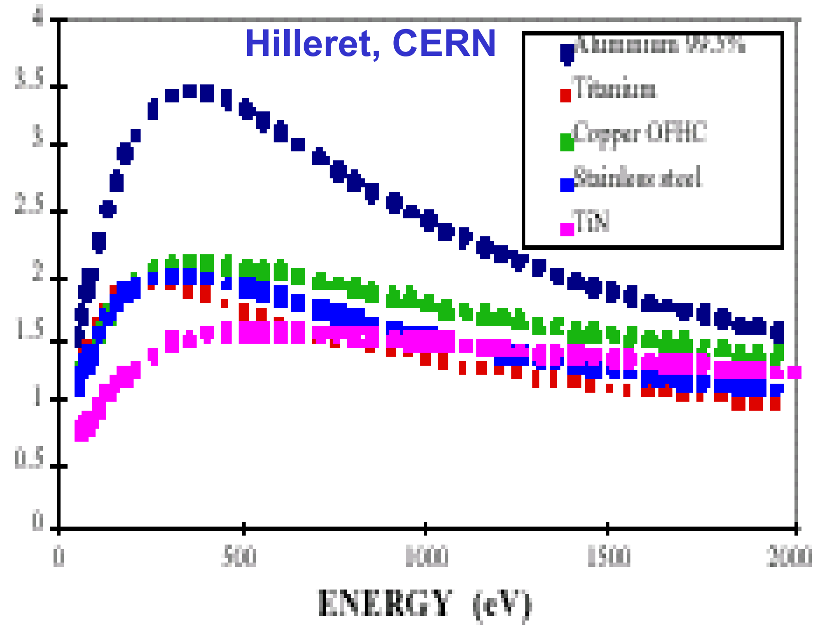
Similar is observed for other surfaces, Cu and NEG

Measure SEY for each coating parameters

Facilities @ CERN, KEK, SLAC

PSR experience with TiN coated chamber?

Beam scrubbing of mC/mm^2!



Chamber Coating – NEG (CERN + ***ESRF*** + Cornell)

To reduce SEY, ESD and provide distributed pumping

- Low SEY of 1.1 - 1.3 after activation
- SEY of < 1.7 (< 1.4 in SPS lab test) after saturation and after H2O saturation.
- As received: < 2.0
- Other SEY data: ~ 1.1 after activation, 1.4 after saturation, 1.9 after overnight?

Coating parameters: 100C, 2e-2 Torr Kr gas

- or 300C coating ⇒ rougher surface but more capacity between activation

NEG Surface is rougher on Al and smoother on SS

- No bonding problem even on Al surface with 1 μm Al_2O_3

Need consistent measurement of SEY from different lab on

- Rough vs. smooth NEG surface
  - 300C vs. 100C coatings
  - Coatings on SS, Al, Cu, Be…

Chamber Coating – NEG (contiune)

Optimum coating thickness: 1 – 1.5 μm (adhesion?)

- Flaking of coating if surface is contaminated.

No impurity during coating

- No pumping with a few percent of O loading (Cornell, ESRF)

Enough capacity for over 10 air vent/activation cycles (depending on T)

Activation temperature of NEG

- 100C – observed some activation (Cornell)
- 180C – ESRF
- 250C – RHIC
- ≤ 300C – LHC LSS; LEIR

Use ion pumps to remove H_2 during re-activation (ESRF)

Impedance is better than Stainless Steel but worse than Aluminum

- 50 μΩ-cm is OK for ESRF but not for KEKB

Chamber Coating - Others

Palladium (Pd) over layer on NEG to prevent H2O and oxide diffusion into NEG during activation, therefore preserve the NEG capacity for H2.

Pd pumping of H2/COreversible by activation @ 100C. Easy to sputter, expensive cathode

Other types of coating - Diamond-like graphite coating

Low SEY but may be difficult to implement for long chambers

Plans at various labs

Cornell – need high H2 capacity down to e-13 Torr (Pd over layer?)

ESRF – will test Pd over layer coating in the near future

KEKB – may test NEG on a straight section for SEY (difficulty to activate)

Compatible with Cu SEY? not advantage from photon scrubbing due to narrow band

PEPII – TiN coating of straight section chambers

LHC LSS – baking @150C, activation @200C - 300C with 0.5mm SS foil heaters

LEIR – NEG coating of SS + Quads, activation @300C

GSI – NEG coating of SIS dipole chambers; low desorption material

Chamber Treatment

Vacuum Firing to reduce H_2 but not helping ESD… (Uppsala)

Universal outgassing data base for insulators… will be beneficial for the community (Uppsala +…)

No electro-polishing after vacuum firing – re-loading of H_2

GDC by Ar + O_2 or He + O_2 is not suitable for heavy ion machine, due to the release Ar and He during beam scraping.

Cleaning:

DI water high pressure wash, then EtOH wipe, no acid etching (Cornell)

DI water rinse till the water passes the conductance test or optical particle counting (Tesla)

High pressure detergent + water rinse, EtOH wipe (RHIC)

Cu chambers – chemical polishing (KEKB)

Test every chamber vs. Test a few chambers vs. Test all special chambers

Thin foil heaters + insulation (~mm) for bakeout and NEG activation of LHC LSS and Expt Pipes