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ISR PERFORMANCE REPORT

Runs 312, 316

Desorption Measurements on "Ti-derms"

R 1, 26 GeV/c (5C26) - 20b.

Experiment

To establish whether solid titanium vacuum chambers, such as may eventually be mounted in the experimental regions of the ISR, suffer from desorption or adsorption in the presence of circulating beams.

Conclusions

Ti-derms appear to be an effective means of converting the ISR into an ion-getter pump (see AR/Int.SR/62-4, "The Storage Ring Model as Ion-pump" by E. Jones and AR/Int.SR/62-7, "Comment ....." by E. Fischer). The short term results are very encouraging but we should continue over the next six months to measure the adsorption coefficients as a function of time and current. Each ISR ring has about 300 m of circular and about 600 m of elliptical vacuum chamber. The cost of equiping one ring with Ti-derms approaches 300'000SF. (circular : 30'000 SF; elliptic : 150'000 SF; material 20'000 SF; these prices include treatment and fabrication but exclude installation costs). At our usual shutdown rate it might take two years to equip both rings. The aperture of the ISR at β_{max}H,V is 150 x 50 mm^2 respectively; a special design of Ti-derm is needed for these regions if one is not to sacrifice any horizontal aperture. A small sacrifice in vertical aperture may be needed !

Equipment and Results

Sector 31, straight section 317, has been equiped with inner skins ("derms") of titanium alloy (13 Cr, 11 V, 3 Al) in the form of cylinders, 50 cm long and 0.2 mm thick, edges turned down and inwards (to "scrape" away beam and

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avoid A-bumps - if they still exist); each tube has a slight undulation and a few holes to allow evacuation of the space between inner skin and vacuum chamber wall.

After fabrication and before mounting in the ISR, each cylindrical Ti-derm was first cleaned in the usual manner and then degassed for 3 hours at 700°C. Such treatment is known to reduce the outgassing rate of titanium to values consistently below about one tenth that of stainless steel.

After installation in SS 317, the region was baked in the usual manner (300°C for 24 hours) but the Ti-sublimation pumps in the area were not activated. (This is consistent with earlier measurements in SS 333 and allows the usual assumption of an $S_{eff} = 60\ cm^3 sec^{-1} cm^{-1}$). The desorption coefficient may then be calculated from

$$\eta = \frac{\left(1 - \frac{P_o}{P}\right)}{\left(\frac{\beta\ I}{S_{eff}}\right)} \quad ; \quad \beta = 7.5 \ ; \quad I \text{ in Amps.}$$

by measuring $\left(1 - \frac{P_o}{P}\right)$ as a function of beam current for a "cleared" beam. The results are shown in the accompanying figure where they are compared with earlier results obtained for different surfaces in SS 333 - always for the case of "cleared" beams.

It can be seen from the figure that the results are encouraging and that up to 16 A values of η are always negative ranging from -0.67 at low (best case) current to -0.17 (worst case) at high current (16 A was the limit at the time of these measurements). The only really competitive surface studied in SS 333 is the freshly sublimated Ti-layer; here it is difficult to compare results of η measurements because the effective pumping speed is not unambiguously defined for both cases. All other results shown in the figure are directly comparable as far as S_{eff} is concerned.

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Note

If one can write

$$P_o = \frac{Q}{S_o}$$

and

$$P_I = \frac{Q}{S_o + sI}$$

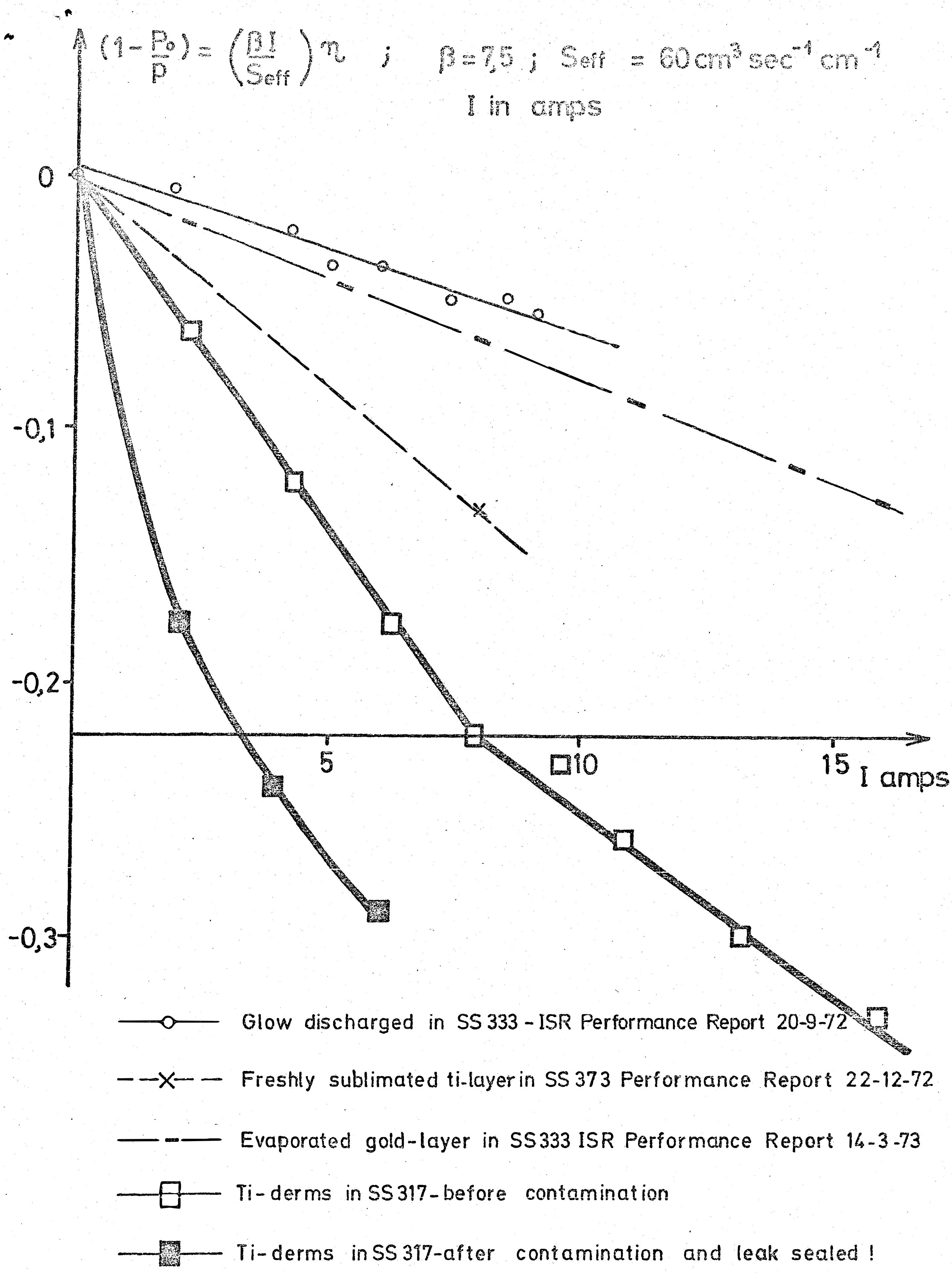
where P_o is the equilibrium pressure with the beam current I = 0 Amps; P_I is the equilibrium pressure in the presence of I Amps; Q is the specific outgassing rate; S_o is the specific pumping speed without beam; (sI) is the added effect due to beam pumping. Using the values of $P_o = 4 \times 10^{-11}$ torr; $P_I = 3 \times 10^{-11}$ torr when I $\sim$ 10 A as found above, one finds :

$$S = 2\ cm^3 sec^{-1} cm^{-1} A^{-1}$$

$$= 0.2\ l\ sec^{-1} m^{-1} A^{-1}$$

which compares well with that calculated by E. Fischer in 1962 (AR/Int.SR/62-7) of 0.22 l $sec^{-1}m^{-1}A^{-1}$, if we assume that $S_o = 60\ cm^3 sec^{-1} cm^{-1}$.

E. Jones (VA), J-C. Brunet (EN).



$(1-\frac{P_0}{P}) = \left(\frac{\beta I}{S_{eff}}\right)\eta$; $\beta = 7{,}5$; $S_{eff} = 60\,cm^3\,sec^{-1}\,cm^{-1}$
I in amps
0
-0,1
-0,2
-0,3
5
10
15
I amps
Glow discharged in SS 333 - ISR Performance Report 20-9-72
Freshly sublimated ti-layer in SS 373 Performance Report 22-12-72
Evaporated gold-layer in SS333 ISR Performance Report 14-3-73
Ti-derms in SS 317-before contamination
Ti-derms in SS 317-after contamination and leak sealed !