



CARE/JRA1/WP4

Research and Development on Superconducting Radio-Frequency Technology for Accelerator Application

Work Package 4 - Thin film cavity production

Work package leader - Prof. M.J. Sadowski (IPJ, Swierk, Poland)

This work package embraces two main tasks:

WP4.1 - Linear cathode arc coating

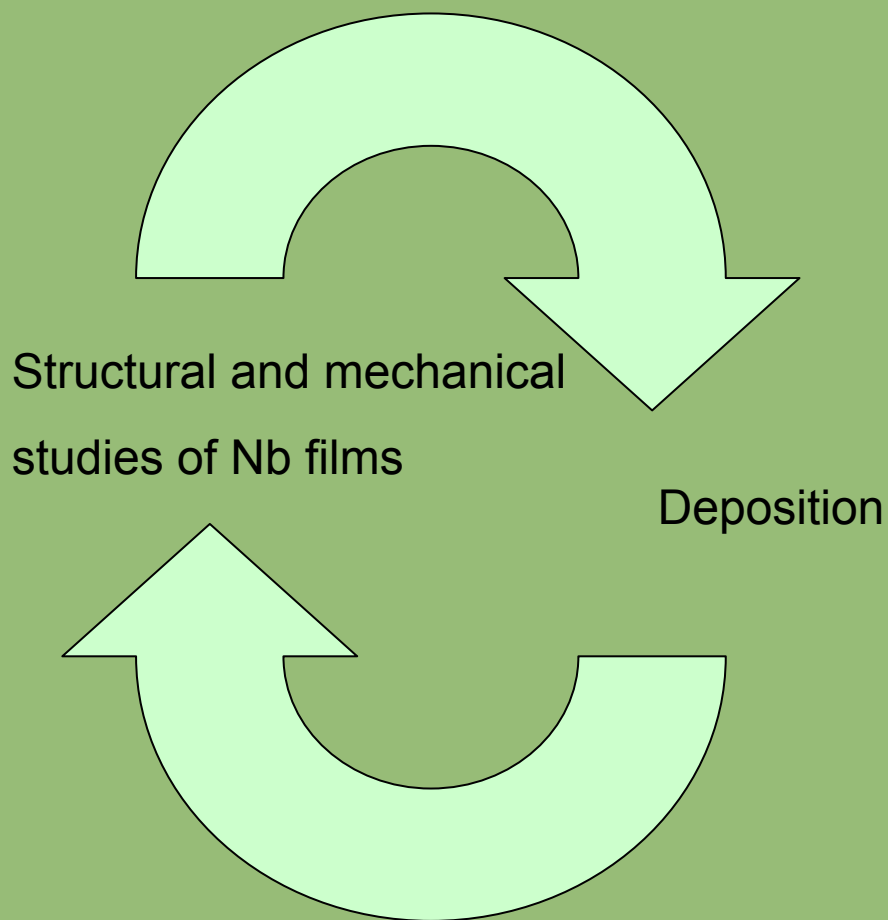
Task leader – P. Strzyzewski then R. Nietubyć (IPJ, Świerk, Poland)

WP4.2 - Planar cathode arc coating

Task leader – Prof. S. Tazzari (Univ. Tor Vergata, Rome, Italy)



Our job

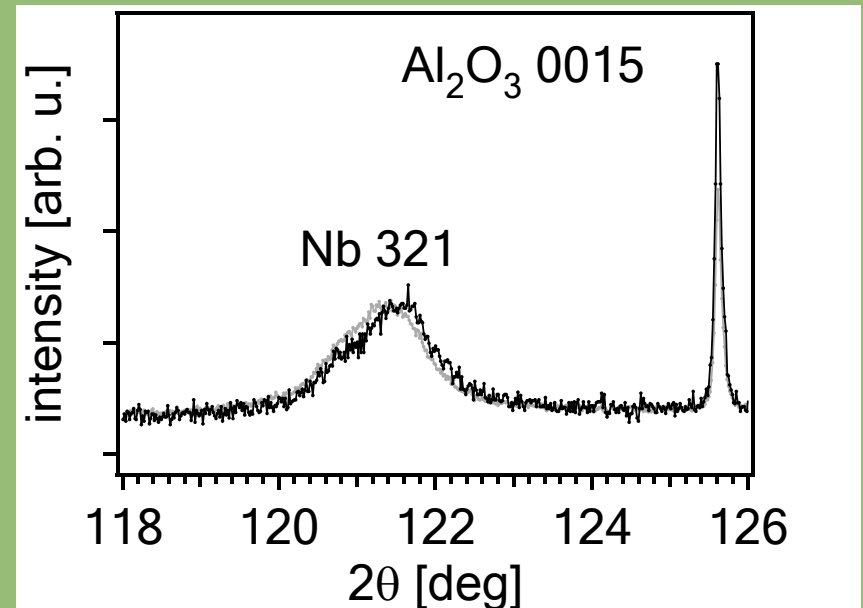
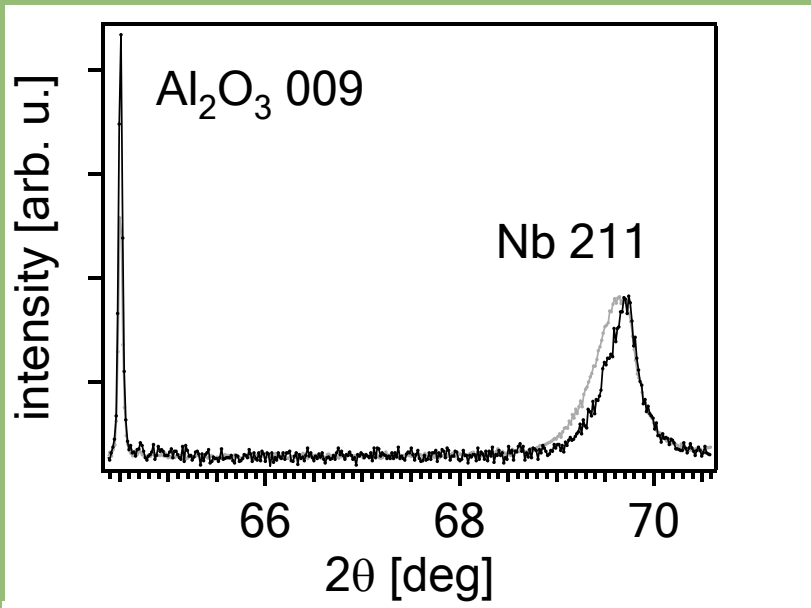


- 4.1 Linear-arc cathode coating
 - 4.1.1 Installation & commissioning of coating apparatus
 - 4.1.1.1 Modification of prototype facility for single cells
 - 4.1.1.2 Optimization of a triggering system
 - 4.1.1.3 Prototype facility ready
 - 4.1.1.4 Study of arc current reduction and stabilization
 - 4.1.1.5 Optimization of powering system
 - 4.1.1.6 Coating apparatus operational
 - 4.1.1.7 Coating of single cells
 - 4.1.1.7.1 Coating of single-cell without micro-droplet filter
 - 4.1.1.7.2 Design and construction of a micro-droplet filter
 - 4.1.1.7.3 Micro-droplet filter ready
 - 4.1.1.7.4 Coating of single cell with micro-droplet filtering
 - 4.1.1.8 Coating multi-cell
 - 4.1.1.8.1 Design and commissioning
 - 4.1.1.8.2 First multi-cell coating



XRD bias vs ground

Nb/sapphire 001

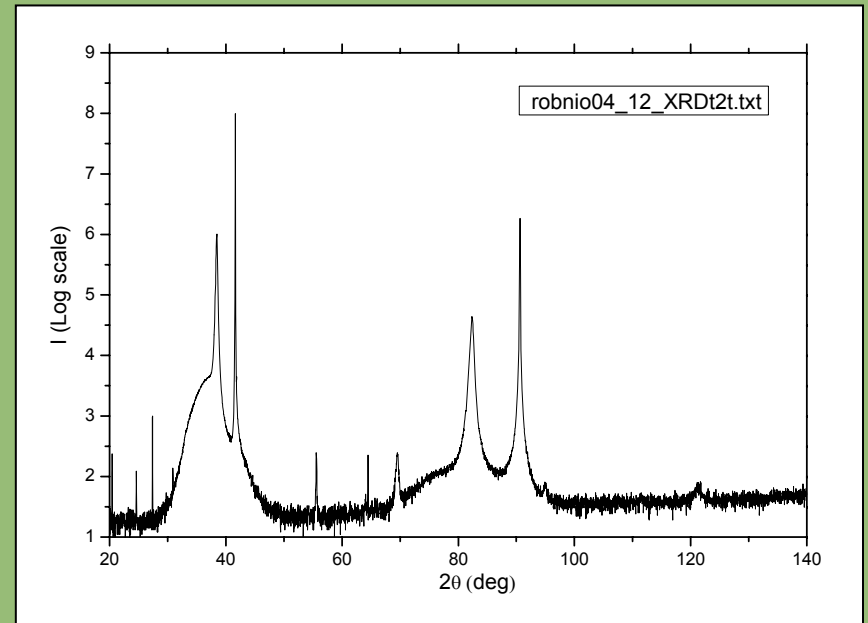
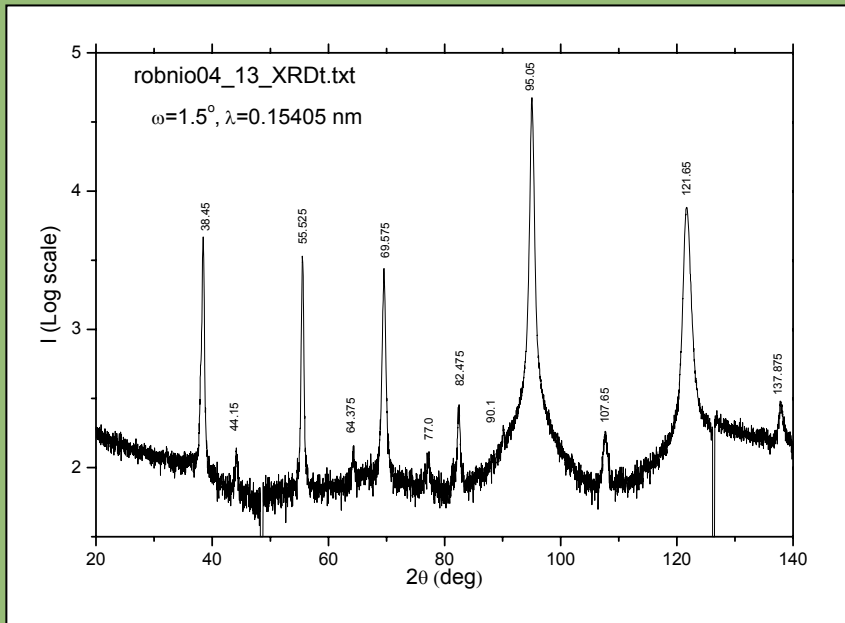


$$a_{\text{bias}\perp} = 3.3046 \pm 0.0091 \text{ \AA} \quad (\text{for bulk bcc } a = 3.3004 \text{ \AA})$$

$$a_{\text{grnd}\perp} = 3.3036 \pm 0.0091 \text{ \AA}$$

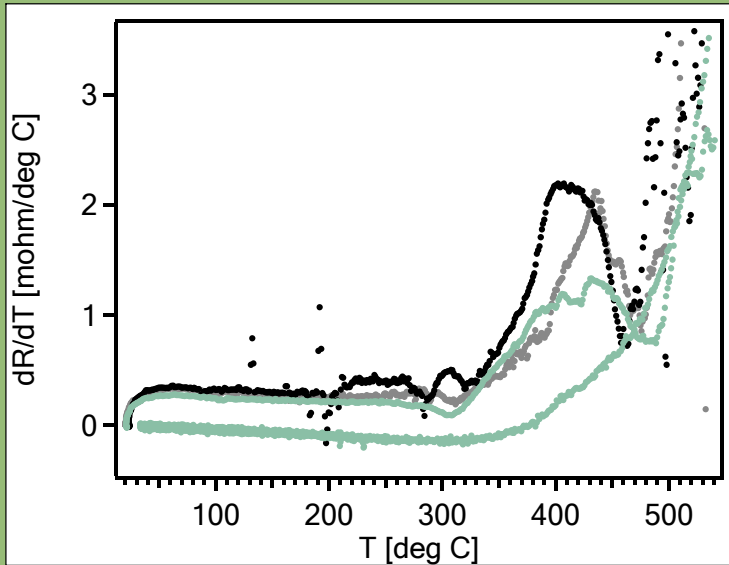


quasi-epitaxy with SR XRD?

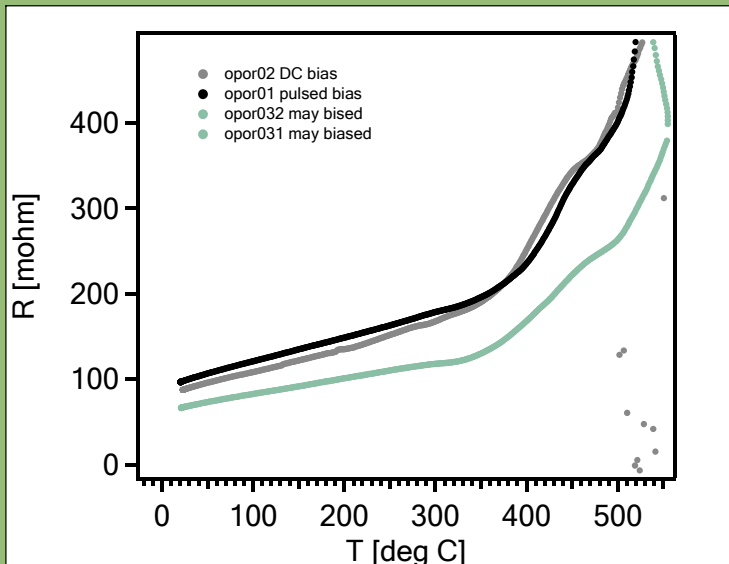




R(T)

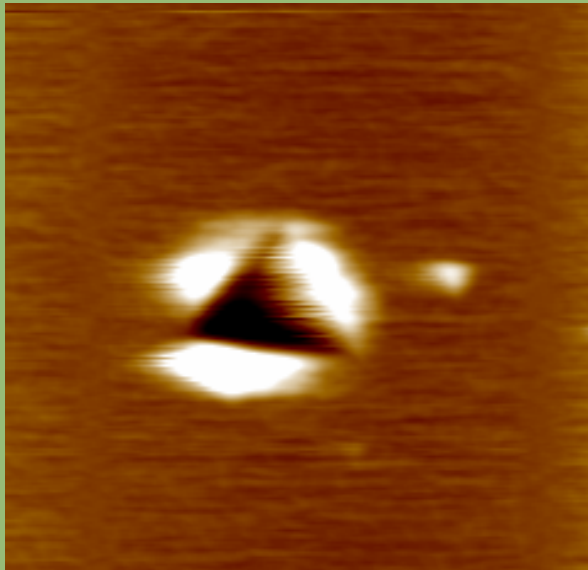


Annealing the Nb/sapphire layers showed some structural changes occurring at 400 °C.

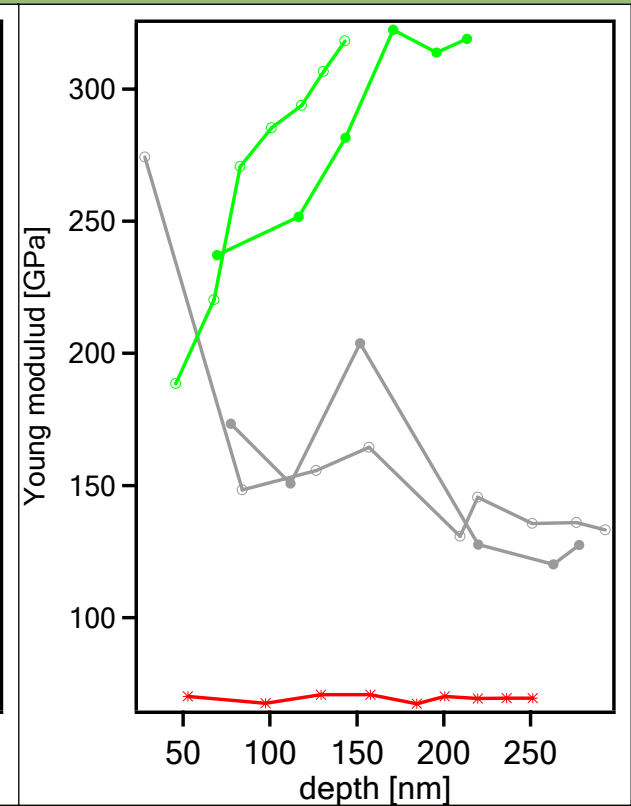
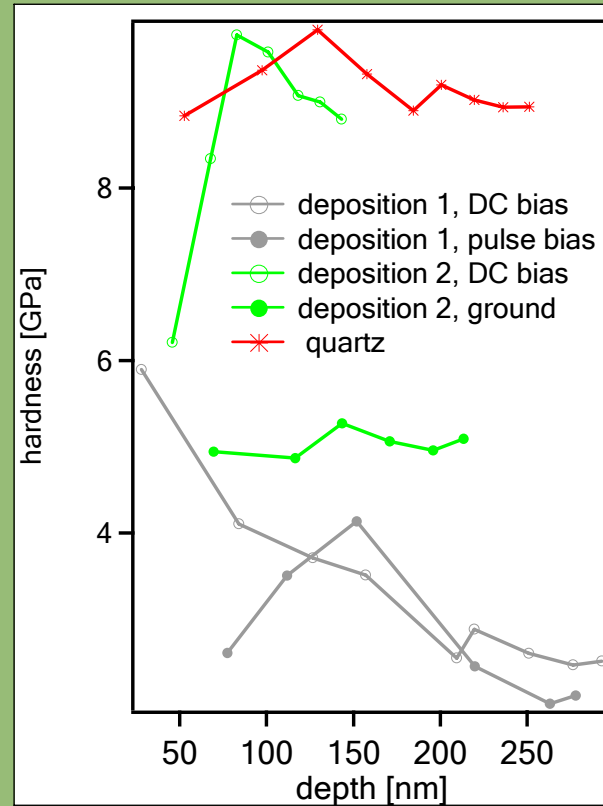




Nanindentation



Hysitron, Ubi 1, Berkowicz tip





Previous deposition

First cavity deposition has failed

Wrong surface preparation

$p = 10^{-8}$ mbar

$U_{\text{bias}} = -60$ V

$f = 10$ kHz, rectangular,
filling = 30%,

$t = 240$ s, 4×60 s



HPR 100 bar

Setup improvements

cooled anode



pulse HV supplier for bias and for arc feeding



Tomorrow...

First cavity deposition failed

Wrong surface preparation

$p = 10^{-8}$ mbar

$U_{\text{bias}} = -60$ V

$f = 10$ kHz, rectangular,
filling = 30%,

$t = 240$ s, 4×60 s

Hopeful second deposition

Improved surface preparation

$p = 10^{-10}$ mbar

$U_{\text{bias}} = -1000$ V

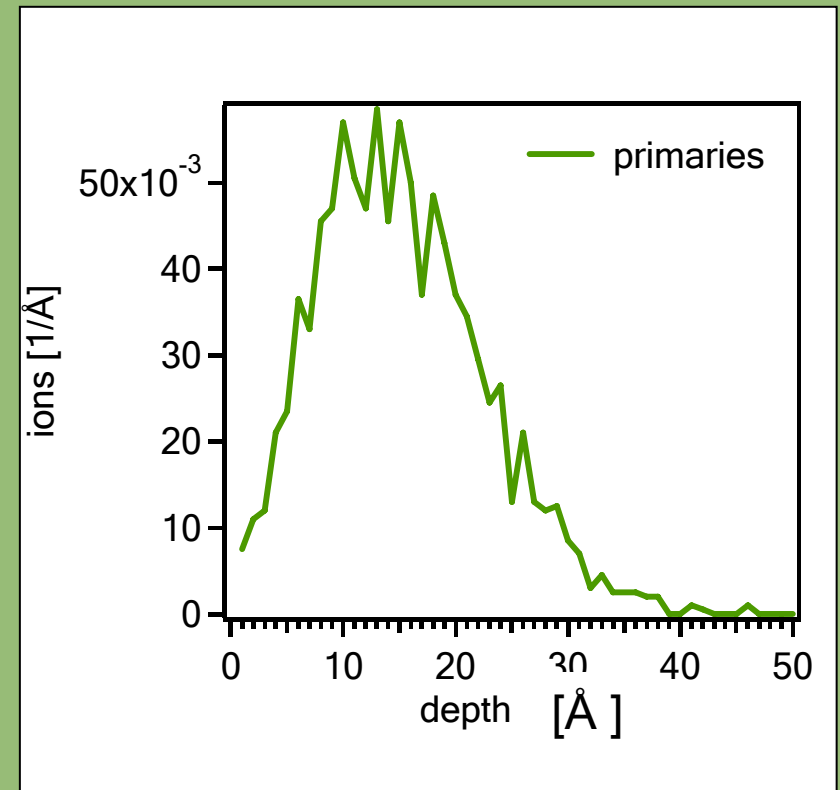
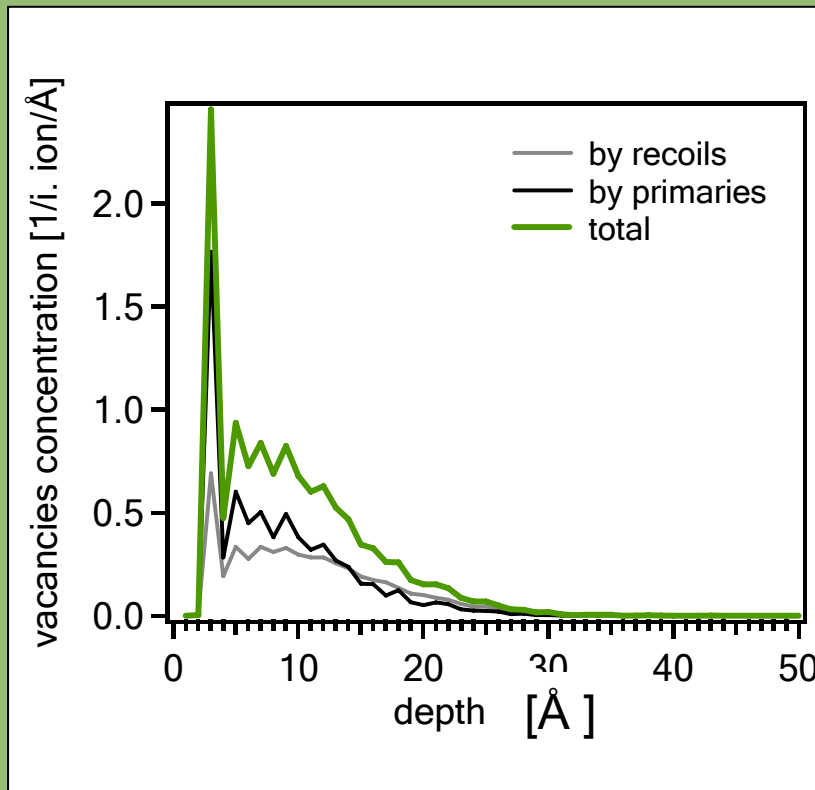
$f = \text{DC or } 0.5$ Hz, rectangular,
filling = 30%,

$t = 600$ s **continuously**



-300 V

Surface modification by 300 V implantation



simulations



Hopeful second deposition

Improved surface preparation

$p = 10^{-10}$ mbar

$U_{\text{bias}} = -1000$ V

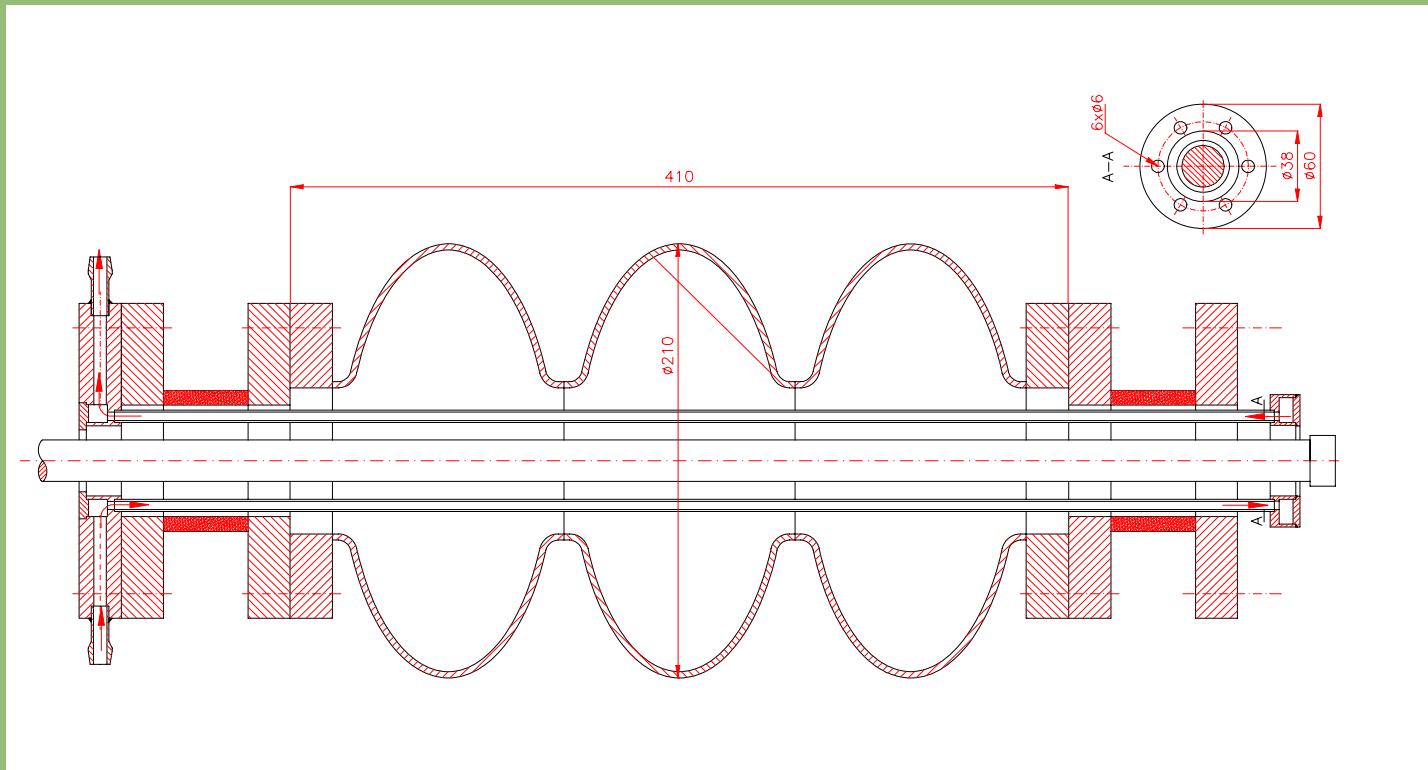
$f =$ DC or 0.5 Hz, rectangular,
filling = 30%,

$t = 600$ s **continuously**

Basing on our experience, we can cautiously, but **reasonably expect successful deposition tomorrow.**

Coming soon

3 cell cavity





EUROCON 2007 The International Conference on "Computer as a Tool" Warsaw, September 9-12

Deposition and Characterisation of Niobium Films for SRF Cavity Application

L. Catani¹, A. Cianchi¹, D. Di Giovenale¹, J. Lorkiewicz¹, V. Merlo², R. Polini², C. Granata³, R. Russo^{3,1*},
M.J. Sadowski⁴, M. Salvato², P. Strzyzewski⁴, S. Tazzari^{1,2}
¹INFN-Tor Vergata, Via della ricerca scientifica 1, 00173, Roma, Italy
²Università di Roma "Tor Vergata" Via della Ricerca Scientifica 1, 00173, Roma, Italy
³Istituto di Cibernetica "E. Caianiello" del CNR, I-80078 Pozzuoli (Napoli), Italy
⁴The Andrzej Soltan Institute for Nuclear Studies, 05-400 Otwock-Swierk n. Warsaw, Poland

EUROCON 2007 The International Conference on "Computer as a Tool" Warsaw, September 9-12

Deposition of Thin Metal Films by Means of Arc Discharges under Ultra-High Vacuum Conditions

Marek J. Sadowski, Pawel Strzyzewski and Robert Nietubyc
The Andrzej Soltan Institute for Nuclear Studies (IPJ), Department of Plasma Physics & Technology (P-V)
05-400 Otwock-Swierk n. Warsaw, Poland, e-mail: msadowski@ipj.gov.pl



Schedule

No.	Task	Begin. of task	End of Task	Status Nov. 2006
4.1	Linear-arc cathode coating	01-01-04	26-10-07	80%
4.1.1	Installation & commissioning of coating apparatus	01-01-04	12-12-06	90%
4.1.1.1	Modification of prototype facility for single cells	01-01-04	14-09-04	100%
4.1.1.2	Optimization of a triggering system	22-03-04	11-10-04	100%
4.1.1.3	Prototype facility ready	11-10-04	11-10-04	100%
4.1.1.4	Study of arc current reduction and stabilization	11-10-04	07-02-05	100%
4.1.1.5	Optimization of powering system	07-02-05	14-03-05	100%
4.1.1.6	Coating apparatus operational	14-03-05	14-03-05	100%
4.1.1.7	Coating of single cells	14-03-05	30-06-07	80%
4.1.1.7.1	Coating of single-cell without micro-droplet filter	14-03-05	31-03-07	80%
4.1.1.7.2	Design and construction of a micro-droplet filter	14-03-05	30-06-06	100%
4.1.1.7.3	Micro-droplet filter ready	31-12-05	30-06-06	100%
4.1.1.7.4	Coating of single cell with micro-droplet filtering	02-01-06	30-06-07	70%
4.1.1.8	Coating multi-cell	30-06-07	28-12-07	10%
4.1.1.8.1	Design and commissioning	30-04-07	30-09-07	20%
4.1.1.8.2	First multi-cell coating	30-09-07	28-12-07	0%



The End