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Gravity Probe B Relativity Mission

PROTOCOL FOR ROTOR COATING IN THE MRC SPUTTERING SYSTEM

GP-B P0079 Rev. -A

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P0079A (DKG00199.doc)
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DKG01146.DOC
GP-B S#0084

PROTOCOL
FOR
ROTOR COATING
IN THE
MRC SPUTTERING SYSTEM

LAYER 1

1. Pickup hardware folder on rotor to be coated.

2. Take 2 flat samples, 1/4" x 1/4" fused quartz,from inventory.

3. Locate rotor to be cleaned.

4. Scribe and break a microscope coverslip into 5 pieces, approximately .2" wide by 1.0" long. Make sure that long dimension is perpendicular to the natural bend of the coverslip.

5. If rotor is new, pre-clean in hot sulfuric acid per GP-B document P#0062. If rotor has an existing coating which is to be stripped, strip niobium coating in hot sulfuric acid per GP-B document P#0062.

6. Weigh the bare rotor, per P0385 (DKG01109.DOC) MEASUREMENT OF ROTOR COATING MASS. Record temperature, relative humidity, barometric pressure, and indicated weight on ROTOR COATING SUMMARY RECORD, DKG00173.DOC. (Attachment A). Enter these values in the program RTRWEIGH located on the IBM PS-2 Model 30 in directory C:\weight.

7. Clean flat samples, coverslip strips, vacuum chuck and Quartz or Silicon rotor, per quartz cleaning procedure GP-B document P0383 (DKG00049.DOC). Note: Rotor should be cleaned last in a separate solution from other parts.

8. Install rotor and samples into system. Place rotor on rollers using vacuum chuck and wand. To use vacuum wand turn on small vacuum pump, be sure wand slide valve is closed. Attach chuck to wand tube, without handling rotor contact surfaces. Open wand slide valve and pickup rotor. When rotor is within volcano mask and resting on rollers, release rotor by pressing finger valve. Close wand slide valve, remove chuck and

store in stainless steel container. Turn off small vacuum pump. Place other samples on the edge of the volcano mask (MSFC DWG. #MD70142-1) using clean tweezers. Make note in ROTOR COATING SUMMARY RECORD, DKG00173.DOC. (Attachment A).

9. Operate sputtering system per operating procedure P0384 (DKG00178.DOC.)

10. Deposit Niobium coating per procedure P0384 (DKG00178.DOC.) for the currently valid time per face recorded in the MRC Operating Log for the 32 faces of the GREAT CIRCLE PATH rotor program COATSMRx, where x is the revision. Make note of activity in ROTOR COATING SUMMARY RECORD.

LAYER 2

12. Operate sputtering system per operating procedure P0384 (DKG00178.DOC.)

13. Deposit Niobium coating per procedure P0384 (DKG00178.DOC.) for the currently valid time per face recorded in the MRC Operating Log for the 32 faces of the GREAT CIRCLE PATH rotor program COATSMR. Make note of activity in ROTOR COATING SUMMARY RECORD.

COATING VERIFICATION AND ANALYSIS

14. After allowing rotor to cool for at least 3 hours, prepare to remove it from system. Standardize Betascope using source Pm/147 with concave fixture, a bare quartz standard, solid niobium rotor, and application number listed in the Betascope Log, or use programs BETSTAND or DECAY as appropriate. Use 10 measurements with each standard. Vent MRC system per procedure P0384 (DKG00178.DOC.).

14.1 Using fresh clean vinyl gloves carefully pickup rotor from rollers and place on Betascope manipulator rollers. Try to maintain orientation of rotor so that top of rotor in deposition station is placed up towards the source/detector and that the front of the rotor, i.e. the point nearest the front of the deposition station is placed nearest the front of the Betascope manipulator, i.e. perpendicular to the plane containing the source/detector, the small bearing, and the center of the rotor. Close chamber and pumpdown per procedure P0384 (DKG00178.DOC.)

14.2 Measure uniformity with the Betascope and print Betascope record sheet. Make note of results in ROTOR COATING SUMMARY RECORD.

14.3 Rotate rotor approximately 10 degrees counterclockwise (from detector towards bearing) on manipulator without moving the detector. Repeat measurement of uniformity.

14.4 Repeat step 14.3 twice more for a total of 4 measurements. If any of the 4 measurement sets have values of P-V, Mass Unbalance or dI/I that differ by more than 30%, discuss these results with the manager.

15. Weigh the coated rotor, per GP-B Document P0385, Process for Weighing Rotors to Determine Mass Added During Coating. Record temperature, relative humidity,

barometric pressure, and indicated weight on the ROTOR COATING SUMMARY RECORD, DKG00173.DOC. (Attachment A). Enter these values in the program RTRWEIGH located on the IBM PS-2 Model 30 in directory C:\weight. The program should calculate the mass added by the coating, and the average coating thickness. Record these values on the ROTOR COATING SUMMARY RECORD.

16. Adhesion test using Scotch tape (Magic transparent tape.) Note any detectable spot failures, notify manager of any failures greater than .010" and place tape with niobium spot on Betascope record sheet. Make note of results in ROTOR COATING SUMMARY RECORD.

17. Clean residue with acetone and then per GP-B document P0383 (DKG00049.DOC).

18. Calculate thickness of 1/4" samples from Betascope average thickness results. Then measure deflection of coverslips and calculate stress using thickness from 1/4" samples.

Stress is calculated as follows:

$$S = 3.01 \times 10^{16} \frac{\Delta d^2}{L^2 t} \frac{\text{dyne}}{\text{cm}^2}$$

or use program ROSTRESS

Δ= deflection in cm.
d= thickness of beam in cm.
t= film thickness in kA.
L= length of beam cm.

If stress is less than +/- 3 x 10^{+9} dyne /cm^2, proceed otherwise stop and discuss with manager. Record average stress value on ROTOR COATING SUMMARY RECORD.

19. Test superconductivity of 1/4" samples with dip probe in liquid helium storage dewar per memo from K.Kaufman, B.Muhlfelder dated 16 September 1987, using Taber probe. Use program TCTEMP to convert diode voltage to temperature. If transition temperature is above 8.2 K, proceed, otherwise stop and discuss with manager. Record lowest transition temperature on ROTOR COATING SUMMARY RECORD.

20. Place in 4 point holder in labeled glass container and place in dry box in HEPL 130. Be sure HARDWARE FOLDER is returned to the HARDWARE FOLDER filing cabinet.

21 Distribute report of coating results to: D.Gill, P.Bayer, B.Muhlfelder, J.Turneaure.

Attachment A

10/21/96 DKG00173.DOC
7/25/88 DKG01147.DOC

ROTOR COATING SUMMARY RECORD

ROTOR I.D. NUMBER _____

MATERIAL HOMOSIL SILICON

DIAMETER _____

	DATE	OPERATOR
CLEANING	_____	_____
DEPOSITION ___SEC/FACE	_____	_____
DEPOSITION ___SEC/FACE	_____	_____

	SPECIFICATION	RESULT	PA
THICKNESS(Betascope)	50+10/-5 µ"	µ"	
THICKNESS(Mass Added)	50+10/-5 µ"	µ"	
P-V UNIFORMITY	2 µ"	µ"	
MASS UNBALANCE	2 µ"	µ"	
$\Delta I/I$	$< 10^{-5}$		
ADHESION RESULTS	< 5 PATCHES > 0.010"		
STRESS	$<3X10^9$ DYNE/CM^2	DYNE/CM^2	

LOWEST T_C	> 8 K	K	

COMMENTS

ID. SHORTHAND FOR COATING LOGS _____

Weighings

	Date	Time	Operator	Temp.	R.H.	B.P "H.G.	Weight	Mass
Bare							grams	gram
Coated							grams	gram

Mass Added	grams
Coating Thickness(implied)	μ"

COATING PROGRAM

Batch File Version: COATSMR___

Recipe File: _____.rcp

Deposition Time	_____sec
Cooling Pause Duration	0.1 sec
RF10 Idle Power	100 Watt
RF10 Deposition Power	600 Watt
Rampup Duration	5 sec
Rampdown Duration	5 sec
Soak Time Duration	10 sec

STRESS BEAMS

Deflection	Thickness	Stress

MEASUREMENT OF TRANSITION TEMPERATURE

Bias Current: 10 mA

	V_s	V_d	T	R/R
1.	_____	_____	_____	_____
	_____	_____	_____	
	↓_____	_____	_____	
	↑_____	_____	_____	
2.	_____	_____	_____	_____
	_____	_____	_____	
	↓_____	_____	_____	
	↑_____	_____	_____	
3.	_____	_____	_____	_____
	_____	_____	_____	
	↓_____	_____	_____	
	↑_____	_____	_____	
4.	_____	_____	_____	_____
	_____	_____	_____	
	↓_____	_____	_____	
	↑_____	_____	_____	

T_c min. _____ max. _____
R/R min. _____ max. _____

Attachment A
(P0079A)

This document lists the program, units and modules that are part of the rotor coating software used to operate the MRC system for coating the Science Mission Rotors. The coating process is controlled by a batch file, **COATSMRA**, which loads the necessary drivers and runs the two executable files, ROTOR1 and TMRDEP18.

The indented list below shows the unit inheritance of the programs.

COATSMRA
ROTOR1
- TPCRT
- TPWINDOW
- TPEDIT
- TPDATE

TMRDEP18
- DISPMRC2
  - MRCDCLR2
  - TPWINDOW
  - TPCRT
  - TPDATE
- DOS
- LFECOMU1
  - MX
  - COMSR232
    - MX
  - TPCRT
  - MRCDCLR2
- LOGGER2
  - DOS
  - MRCDCLR2
- MOVEUNIT
  - TPCRT
  - IEEEPAS
  - MRCDCLR2
  - DEPPAT
    - MCRDCLR2
- MRCDCLR2
- P818UNIT
  - TPCRT
- PPGUNIT
  - TPCRT
  - MX
  - COMRS232
  - MRCDCLR2

RECIPE1
    DOS
    TPCRT
RF11PCLU
    MX
    COMRS232
    DOS
    TPCRT
TPCRT

Unit or Program name	Create Date
COATSMRA	10/21/96 06:10 PM
COMSR232	07/13/96 11:32 AM
DEPPAT	10/21/96 06:08 PM
DISPMRC2	10/21/96 06:03 PM
DOS	MS-DOS 6.22
IEEEPAS	CEC 488 v 3.16
LFECOMU1	07/13/96 01:11 PM
LOGGER2	07/02/96 01:04 PM
MOVEUNIT	07/24/96 05:36 PM
MRCDCLR2	07/18/96 01:17 PM
MX	Advantech PCLS-802 Rev. 4.00
P818UNIT	08/07/96 09:33 AM
PPGUNIT	07/18/96 01:06 PM
RECIPE1	07/18/96 01:16 PM
RF11PCLU	07/18/96 02:41 PM
ROTOR1.pas	12/23/95 10:47 AM
ROTOR10.rcp	10/21/96 06:13 PM
TMRDEP18	10/21/96 05:53 PM
TPCRT	Turbo Professional Version 5.22
TPDATE	Turbo Professional Version 5.22
TPEDIT	Turbo Professional Version 5.22
TPWINDOW	Turbo Professional Version 5.22

Attachment B (TO P0079-A)