



Investigation of Nb material for HOM housing

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Introduction

The Nb material for HOM housing of TESLA cavity were used to be produced by HERAEUS. But, they stopped production.



In current situation, HOM housing can be produced from Nb block by machining or welding of Nb tube and disc.

→ Price increases



- **KEK has been developing the production of HOM materials since 2021 with Japanese companies.** (Shinohara Press Service Co.,Ltd. and Katagiri Seisakusho Co., Ltd.)
- In recent years, these companies has established a production procedure.
- KEK started collaboration with DESY about this investigation.
- More than 50 cups were produced to DESY in 2025.

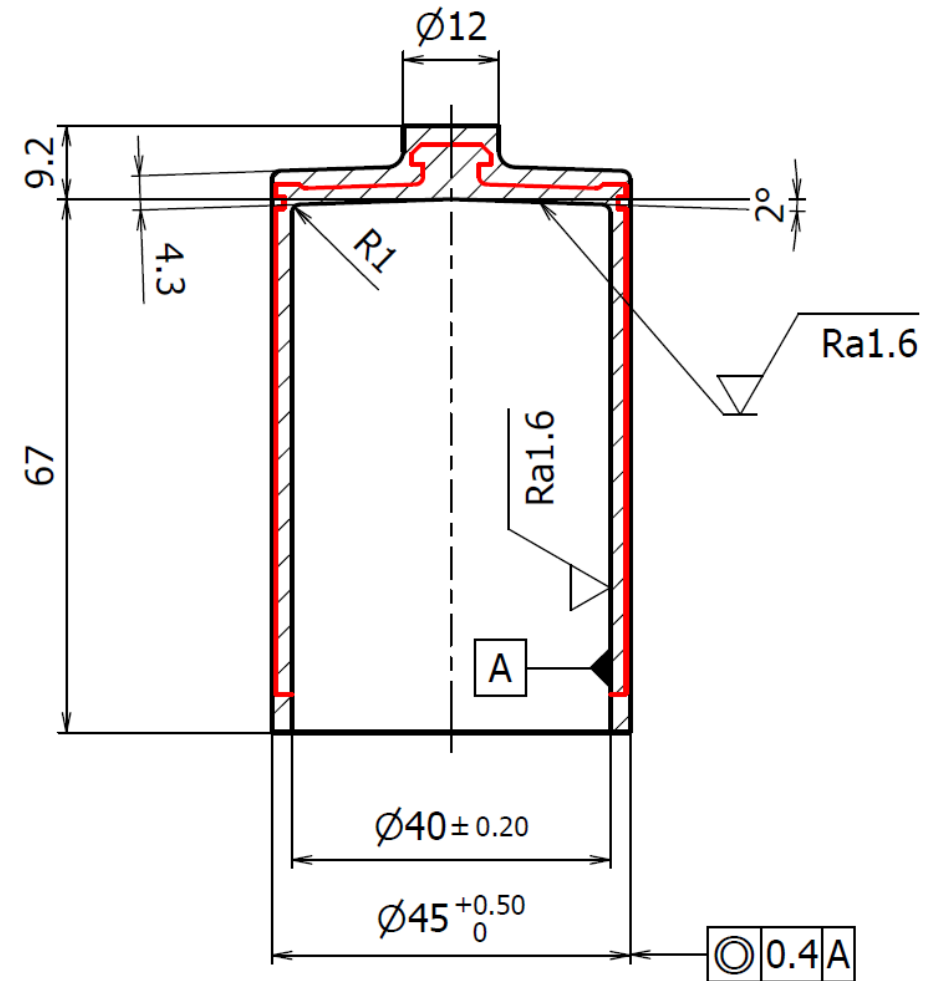


Material produced by HERAEUS



Products

Aiming “no machining inside”. Only machining of outside is necessary.

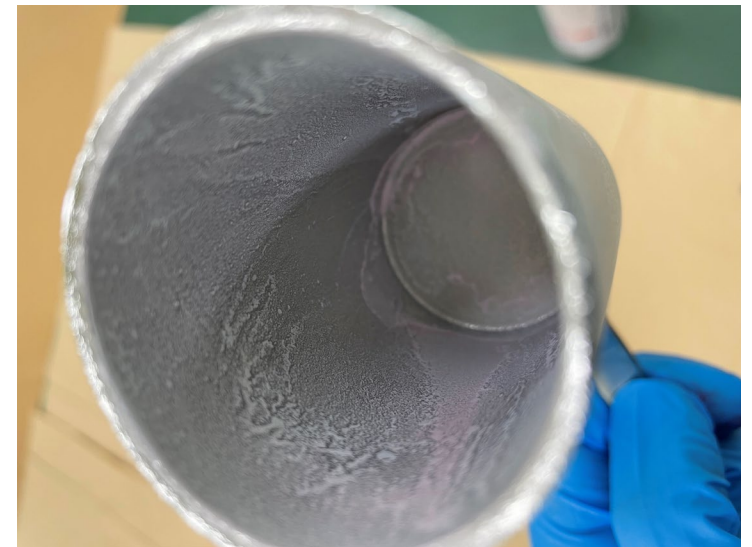


EP simulation

100 μm of Lab EP was performed at KEK. After EP, color check was done.



No crack was found.



Shape accuracy

Niobium Coupler Housing

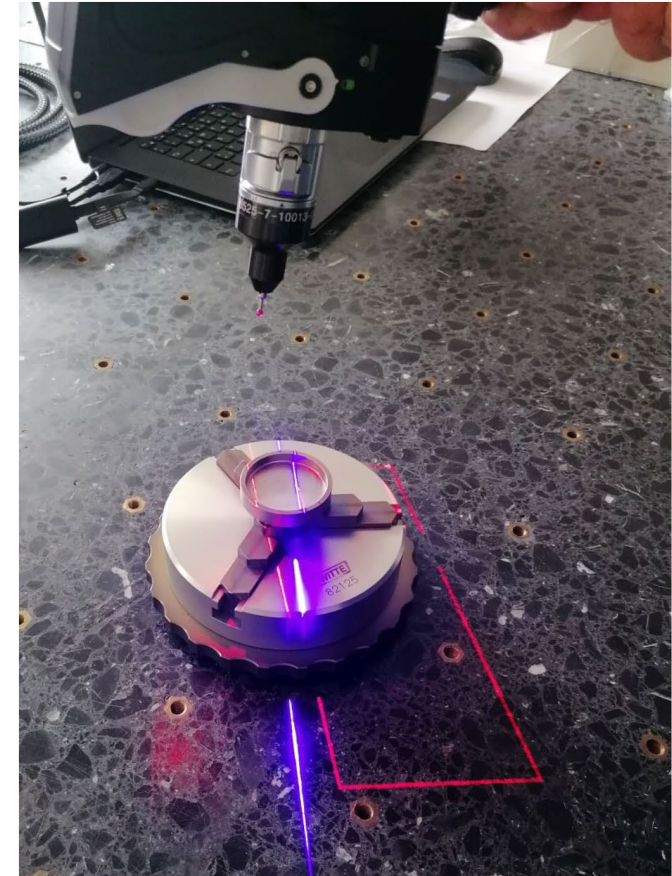
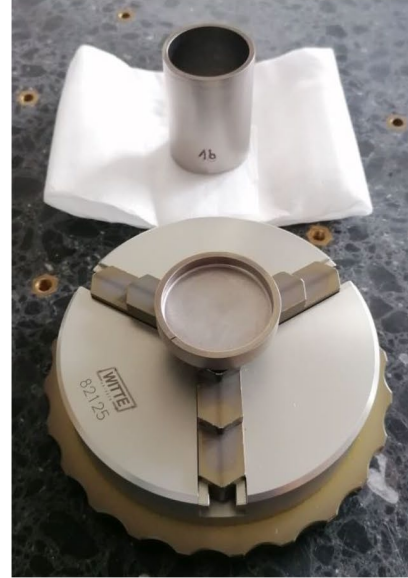
Used shape testing device

Portable Measuring Arm

HEXAGON Absolute, 7 Axis



3D laser scanner

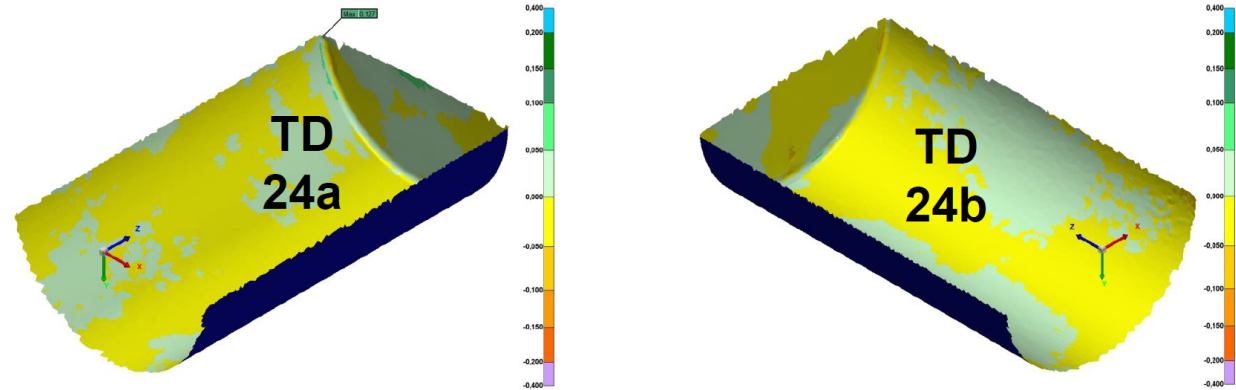


Niobium Coupler Housing

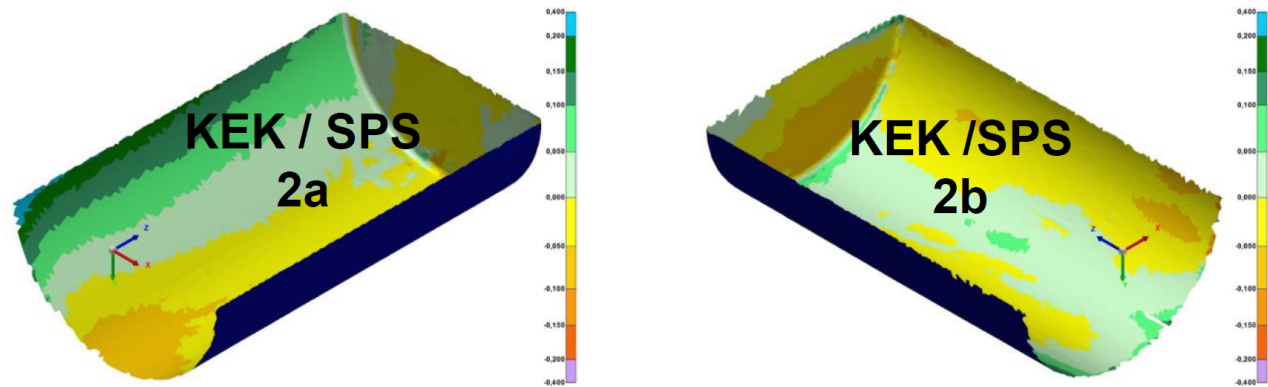
Coupler housing - shape testing

HOM halves by comparison

sample affiliation: DESY order 236/5500024104



DESY SN	Vendor SN	+0.05 to -0.05	+0.1 to -0.1	+0.2 to -0.2	+0.2 to +0.4	-0.2 to -0.4	max +	max -
CH01857	24 (a)	97,5%	100%	0%	0%	0%	0.127 mm	-0.083 mm
CH01857	24 (b)	98.5%	100%	0%	0%	0%	0,079 mm	-0.076 mm
Sample 2a	-	62.7%	88.9%	99.1%	0.89%	0%	0.272 mm	-0.101 mm
Sample 2b	-	80.7%	98.4%	99.8%	0.12%	0.08	0,299 mm	-0.100 mm

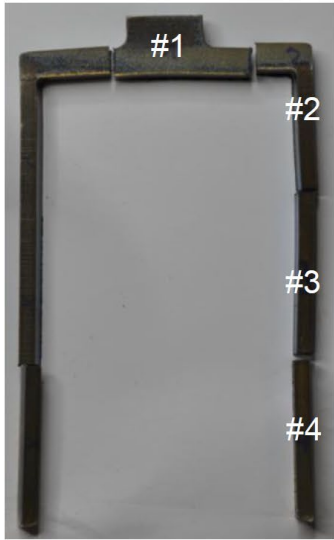
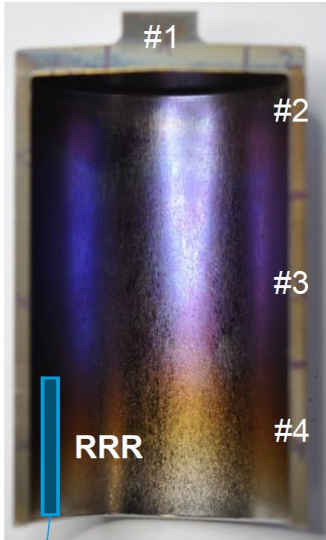
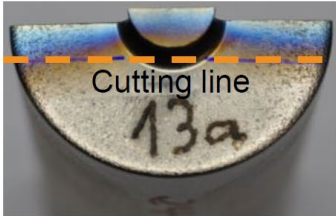


affiliation: production sample kindly provided by KEK in 2023

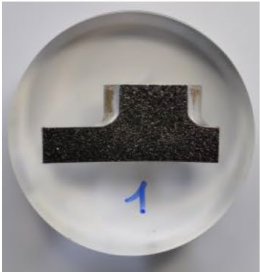
Quality Test Report

Coupler housing – Samples locations

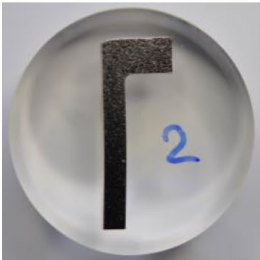
for **Microstructure/Hardness** meas.
embedded/polished samples
etched in **BCP** solution (3-5 min.)



All the samples were
polished along the cutting
line → the surfaces of
all samples are mirrored



#1



#2



#3



#4

RRR=316

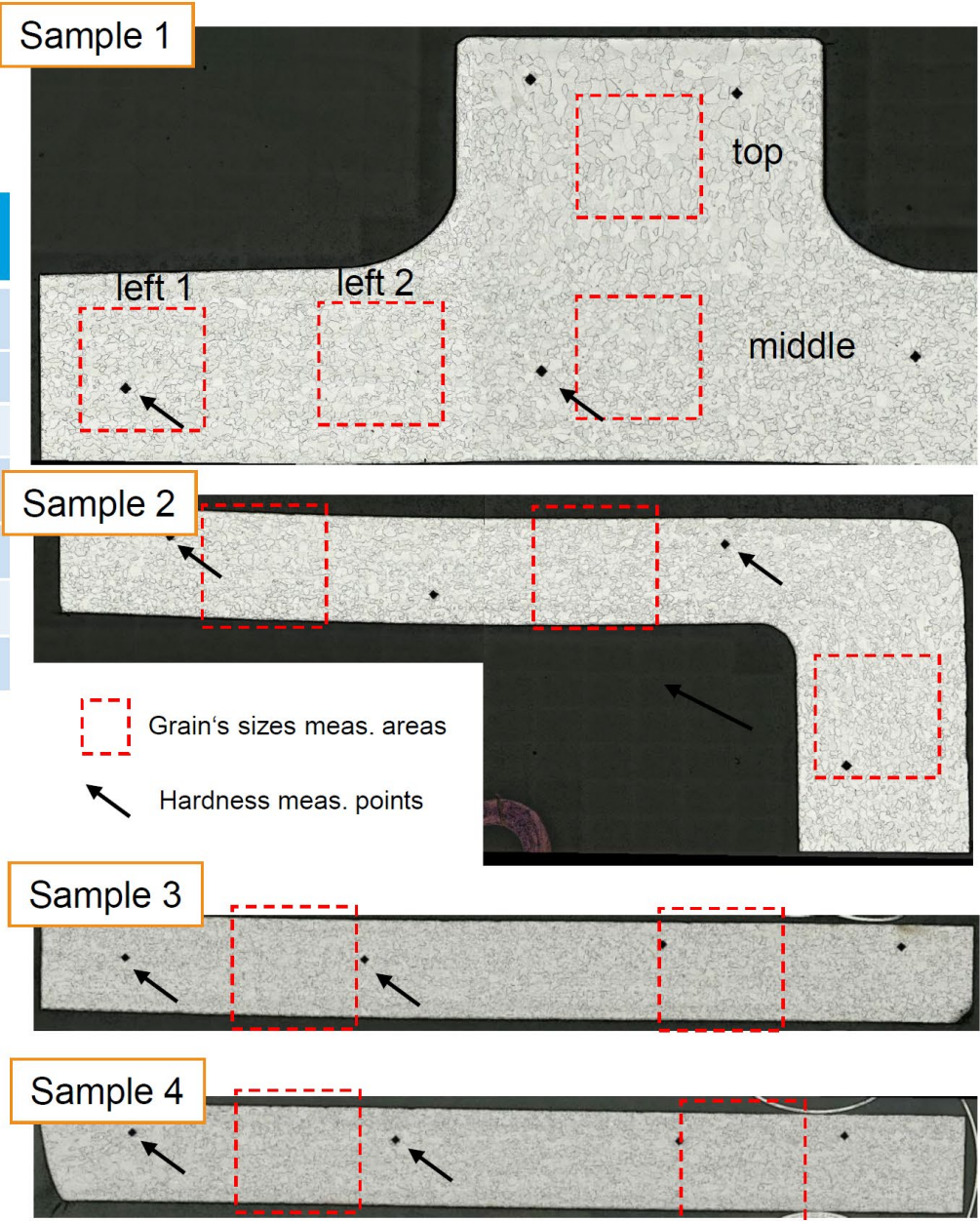
The RRR sample was cut from the
depth of the antenna housing to
avoid the influence of the deformed
outer surface on the RRR value.

Quality Test Report

Coupler housing – general results

Sample Nr.		Hardness, HV2					$\overline{HV}$	Grain size, ASTM G (μm)		
1	top	53,1	52,0	55,6	48,6	52,8	52,4	2,53 (133,24)		
	left 1							3,9 (82,71)		
	left 2							3,48 (95,81)		
	middle							3,26 (103,38)		
2		47,8	61,4	56,4	58,7		56,1	3,57 (92,24)	4,07 (78,18)	3,96 (81,11)
3		53,7	60,8	60,3	55,4		57,5	3,58 (92,68)	3,71 (88,49)	
4		57,8	61,1	61,1	60,9		60,2	3,0 (113,03)	3,43 (97,45)	

Crystals are destroyed by forming, but they re-crystallized after annealing. And they are uniform.



Summary

- KEK has been developing the production of HOM materials for TESLA cavity since 2021 with Japanese companies. (Shinohara Press Service Co.,Ltd. and Katagiri Seisakusho Co., Ltd.)
- Forming technique was established by these Japanese companies.
- Tokyo Denkai produced a series of 50 pieces for DESY successfully.
- Products almost fulfill the requirements for cavity fabrication by DESY.
Note: The roughness of inner bottom surface sometimes exceed requirements.
($R_a \sim 3\mu\text{m}$ wrt the requirements of $1.6\mu\text{m}$)
- KEK and DESY are now trying to use this material to the cavity.
- Now, Tokyo Denakai is managing this production.

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