CLIC TD26CCR1 prototype fabrication

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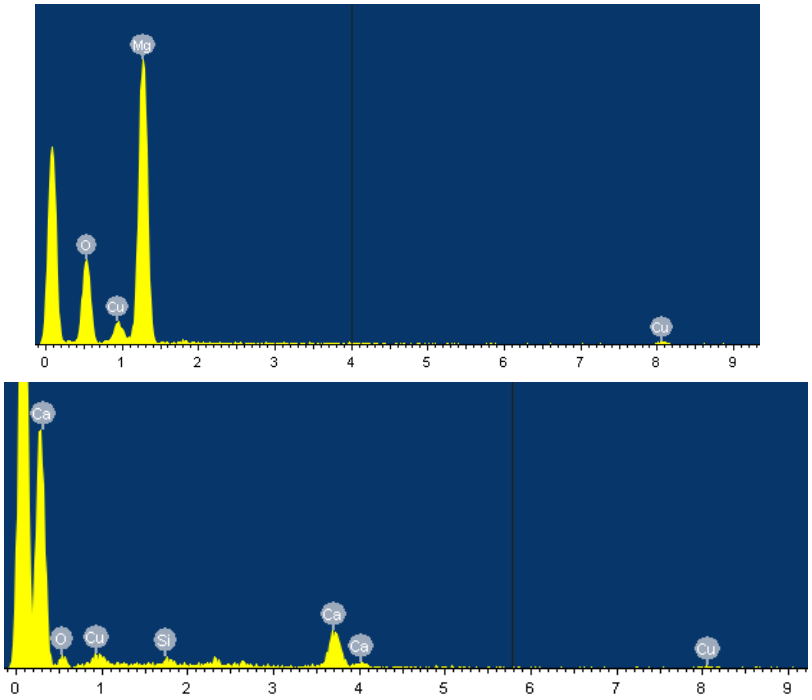
Furnace qualification

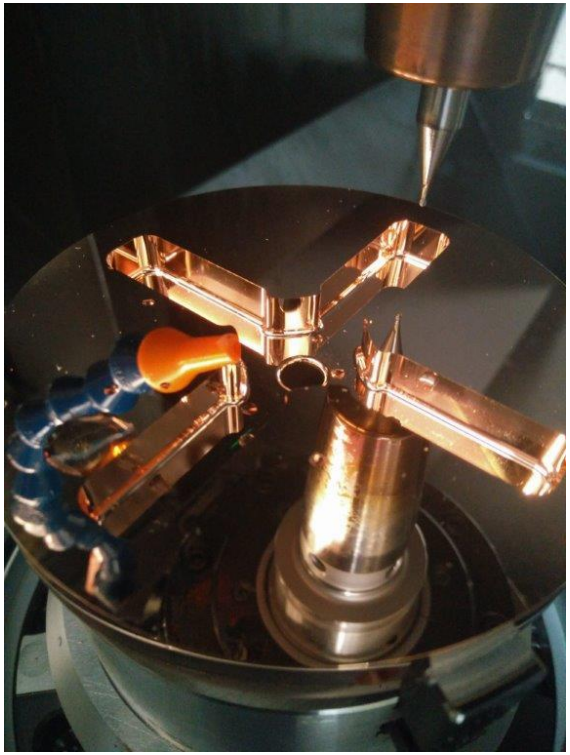
- Thermal cycle in the furnace with witness copper discs in hydrogen atmosphere (few mbar pressure)
- SEM qualitative contamination analysis before / after the cycle
- One candidate furnace close to the machining company did not pass the qualification due to apparition of Mg and Ca particles
- Ongoing furnace qualification with a second candidate

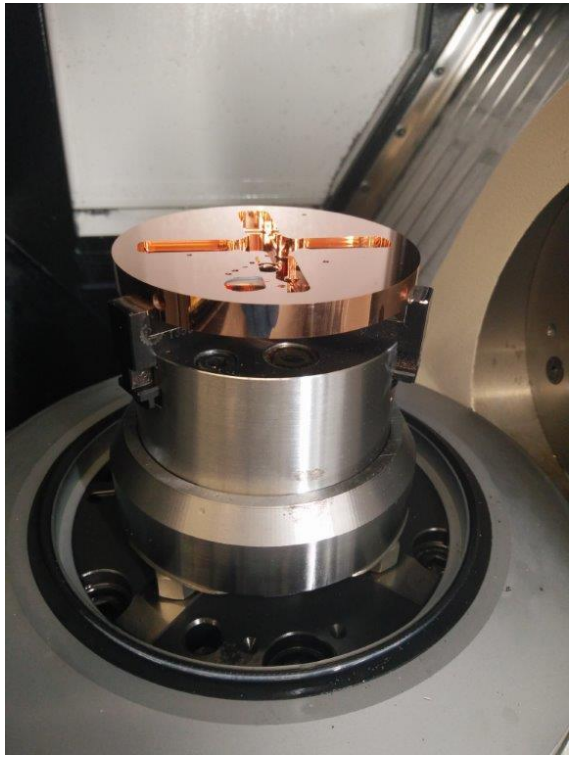
DISC No. 5		BEFORE		AFTER	
PARTICLE TYPE		34 samples		41 samples	
Main elements	Others	No	%	No	%
C, Cu	O, Cl	11	32,4%	2	4,9%
C, O	Cu, Cl, S, Ca, Al, Si, K, Fe, S	10	29,4%	7	17,1%
Mg, O	**Cu, Si, Ca**	**0**	**0,0%**	**7**	**17,1%**
Cu, O	Cl, K, Na, S, Ca, Mg, Al, Si	4	11,8%	6	14,6%
Ca, O	**Si, Cu, Br, P, Al, S, Cl, Mg, K, Fe**	**1**	**2,9%**	**5**	**12,2%**
Si, O	Cu, Mg, Al, Ca, Fe, K, Cl	4	11,8%	3	7,3%
C, Si, O	Cu, Mg, Al, K, Fe	2	5,9%	0	0,0%
C	O, Si, S, Cu, Cl, Ca	1	2,9%	2	4,9%
Cu, Ca, O	**Al, Si, S, Mg, Cl**	**1**	**2,9%**	**2**	**4,9%**
Cu	Ca	0	0,0%	2	4,9%
Cu, Mg, O	**Si, Fe**	**0**	**0,0%**	**2**	**4,9%**
Al, O	Si, Cu	0	0,0%	2	4,9%
Ca	S, Ru, Eu	0	0,0%	1	2,4%



Fabrication of discs (DMP)

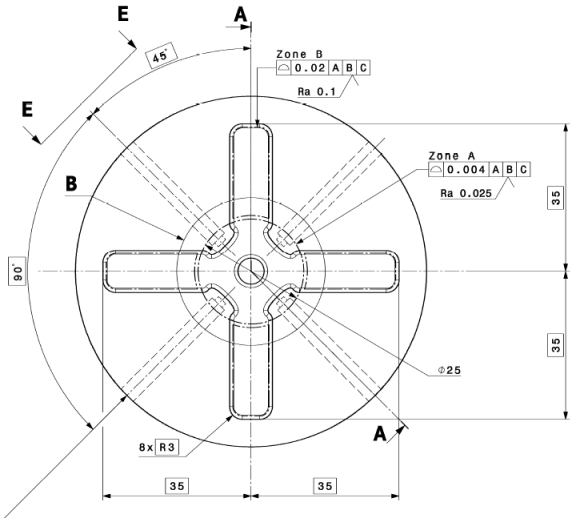
- Three trial disks already fabricated (#2, #13 and #2) on a high precision machine with diamond tools.
- The process is aimed to reduce costs and allow industrialization.
- Iris produced by milling with very low roughness. No step around the iris.

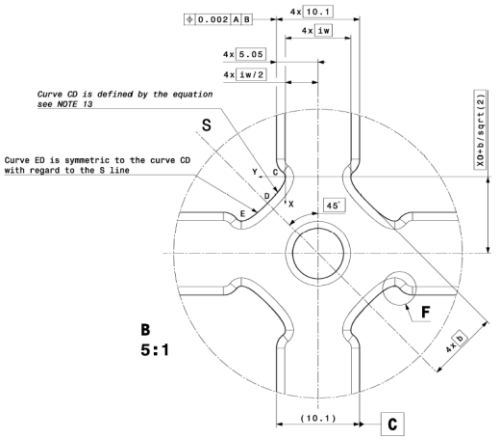




Photos courtesy of DMP

Fabrication of discs: dimension control





Dimension (microns)	Tolerance	Trial 1 (disc #2)	Trial 2 (disc #13)	Trial 3 (disc #2)
Reference surface flatness	1	1.0	1.4	1.2
Outer diameter	+/- 1	-2.7	0.0	1.6
Outer cylindrical face perpendicularity	2	0.1	0.2	0.1
Vertical HOM guides position	+/- 1	0.4	1.0	1.0
Horizontal HOM guides position	+/- 1	1.8	-1.3	-0.5
HOM guides inlet shape	4	3.9/2.2/3.1/2.4	2.9/4.7/2.8/5.2	2.5/3.1/2.2/3.9
HOM guides inlet position	+/-2	3.5/3.1/2.8/<2	2.9/2.8/<2/3.2	2.2/<2/<2/2.4
Iris concentricity	2	3.9	4.5	2.8
Base flatness	1	0.8	1.1	0.9
Thickness	+/- 1	-1.4	0.2	-0.8

Machine blocked during turning. Non-recurrent error.

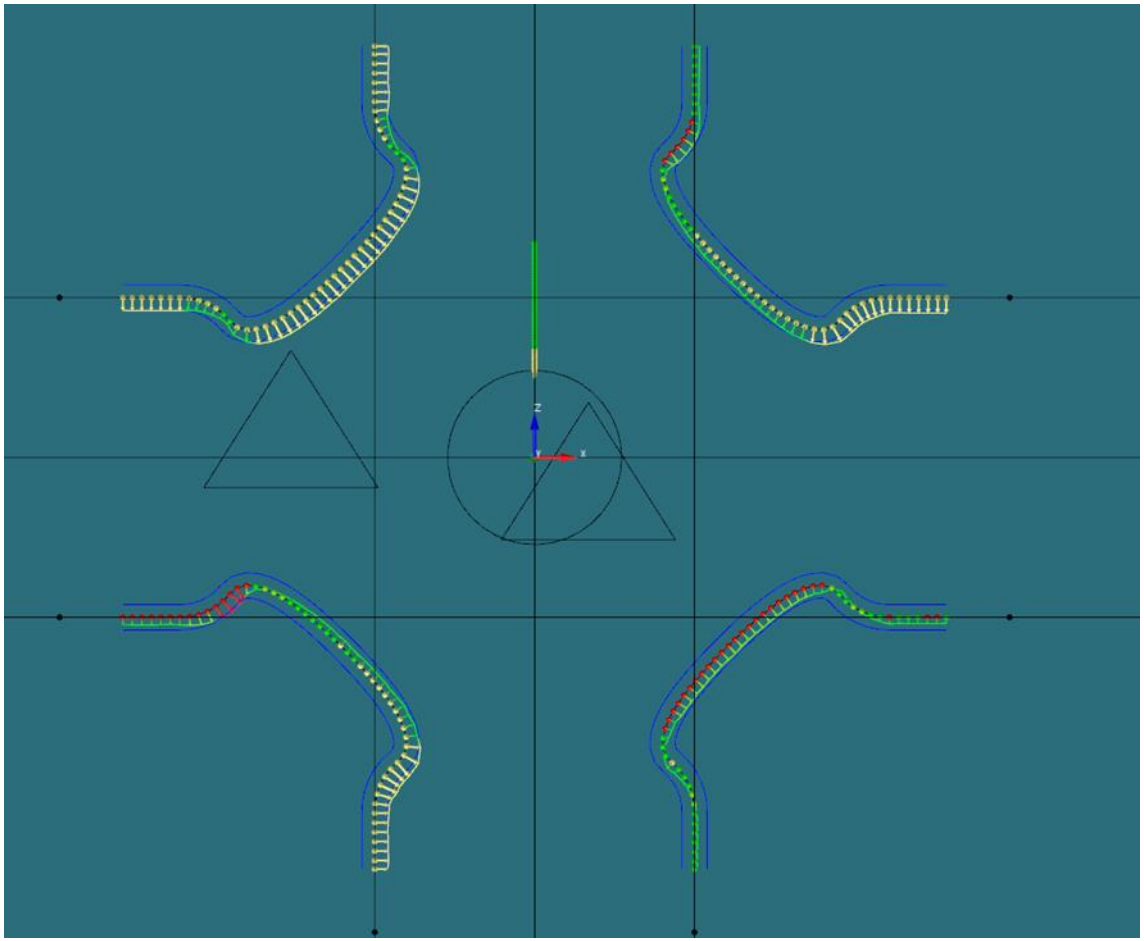
Is it a systematic error in the machine?

See next slide

Due to misalignment between milling and turning

Fabrication of discs

2nd trial disk (#13)



Profile displaced: about 2 µm

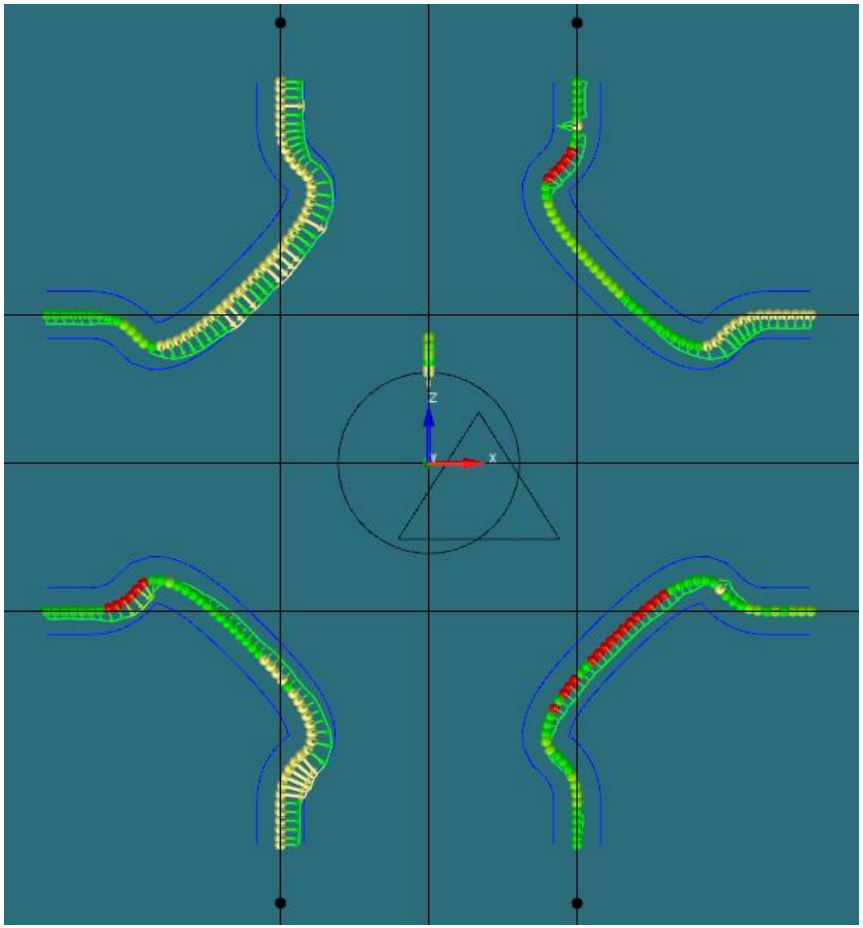
Trying to understand if it is a systematic deviation

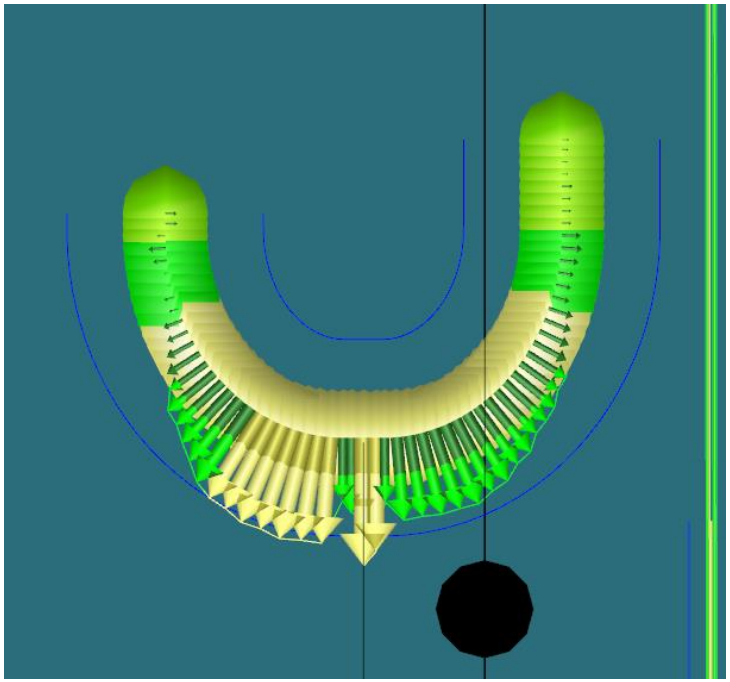
Shape is within tolerances

Only problems with positioning

Fabrication of discs

3rd trial disk (#2)

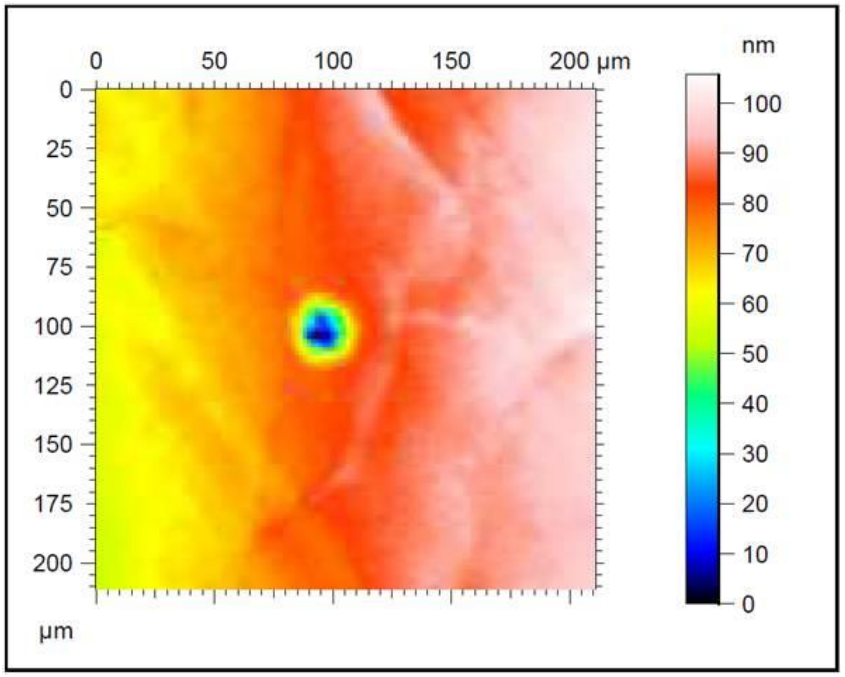




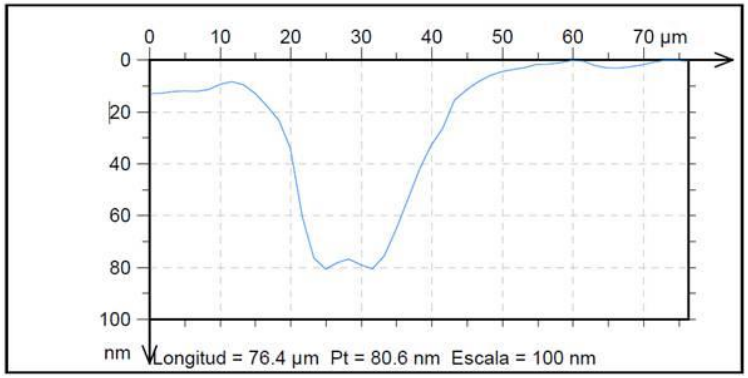
Waveguide nose shape is fine, slightly off-position

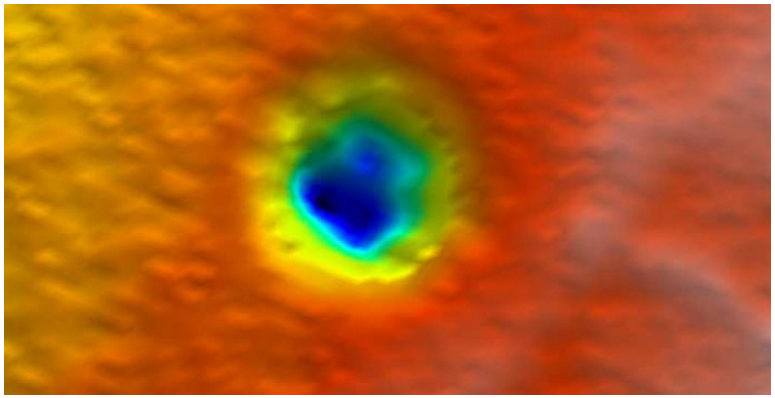
Iris shape tolerance is fine, but 0.3 micron off-position

Fabrication of discs



- Leitz Infinity 3-D coordinate measurement machine uses ultra-low force gauge
- The depth of the deformation is about 80 nm
- Measurements on series discs under discussion, likely the iris profile will not be measured





Fabrication plan

- Discs:
  - Two more trial discs aiming to solve the pending problems with dimension tolerances.
  - Series fabrication of 26 discs for one accelerating structure.
- Production of the other parts: couplers, ports
- Bonding tests with discs with simplified geometry (not high precision at the iris and waveguides, only at bonding surfaces).