Brief update of mitigation studies at KEKB

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KEK

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EC studies in this spring run

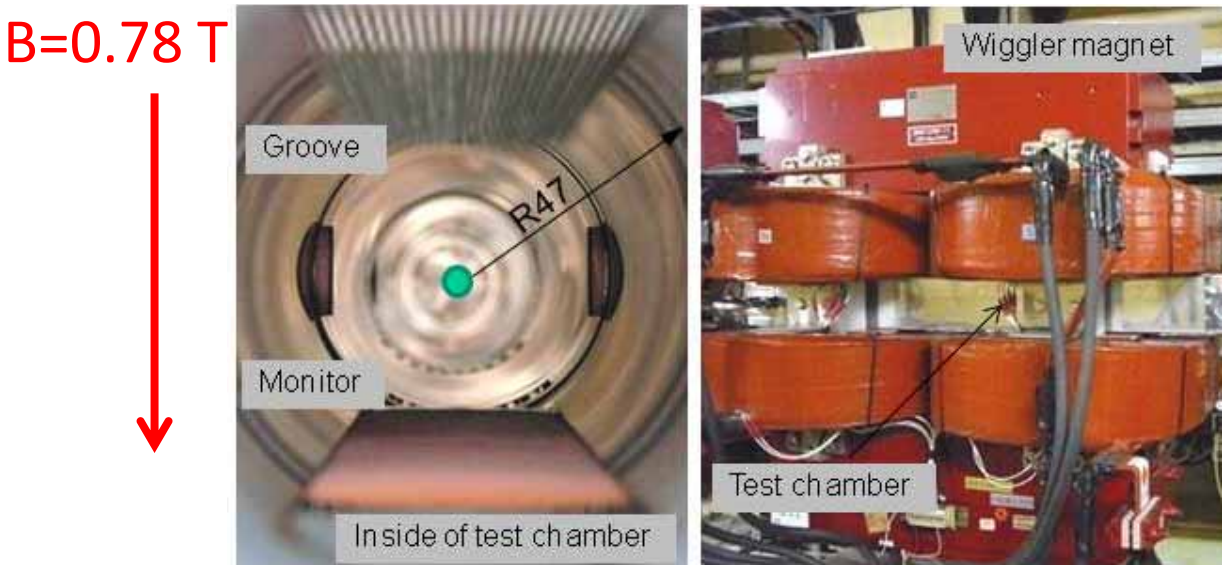
- KEKB
  - This run: 12th, May ~ 30th, June.
  - The last run

- Study items
  - Groove
    - in a dipole magnet (Groove test #1)
    - in a dipole magnet (Groove test #2)
    - at a drift space (Groove test #3)
  - Clearing electrode
    - at a drift space and with a weak dipole field (≤ 90 G)
  - DLC coating
    - At a drift space

Reported here

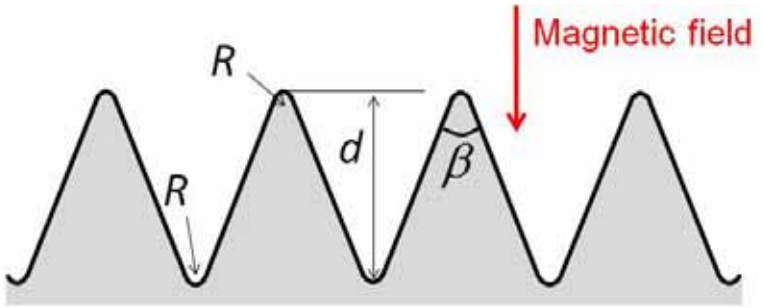
Groove test #1

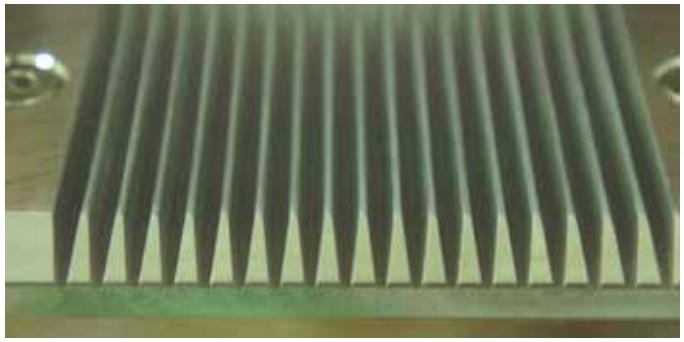
- Experiment using a test chamber with an electron monitor with RFA.
- Inside of a wiggler magnet (0.78 T)
- Since 2008.
- Clearing electrode and grooves have been tested.
  - We have reported the results so far in many occasions.



Groove test #1

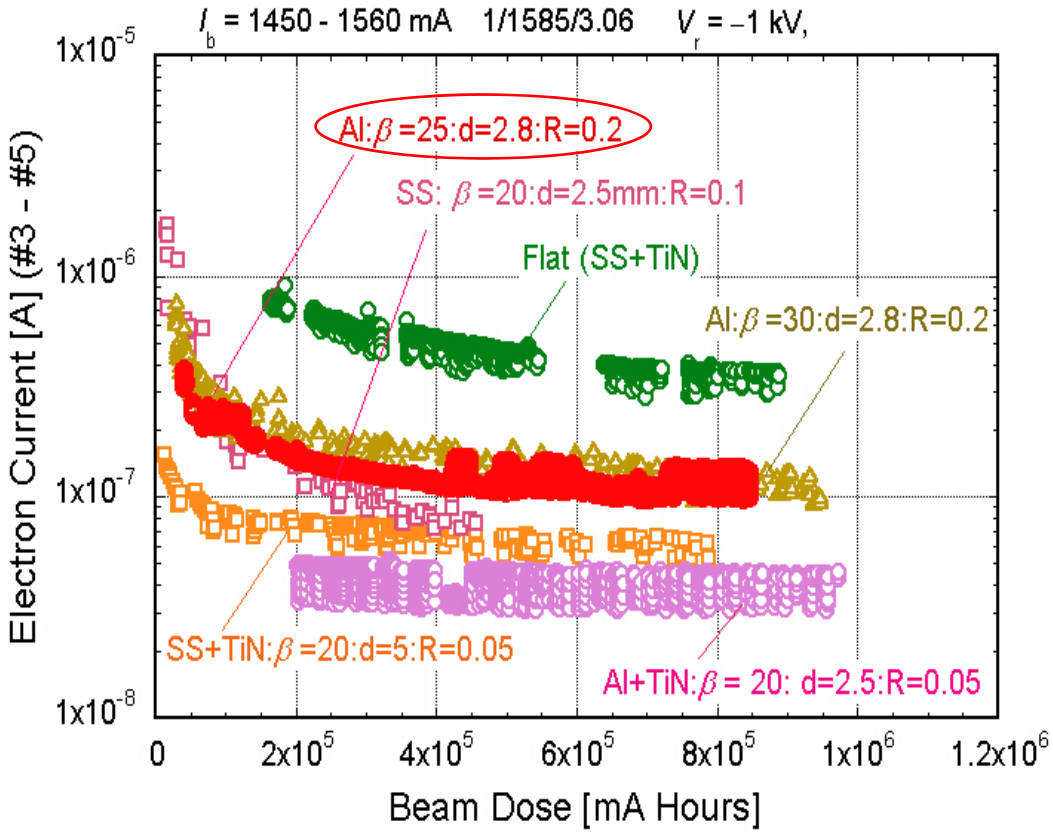
- Various kinds of triangular grooves have been tested.
  - β = 20 ~ 30°, R = 0.05 ~ 0.2 mm, d = 2.5 ~ 5 mm
  - Aluminum, SS
  - Reference: A flat surface with a TiN coating (SS)
- In this run, an aluminum groove with β = 25°, R = 0.2 mm and d = 2.8 mm, considering the mass production by the extrusion method.





Groove test #1

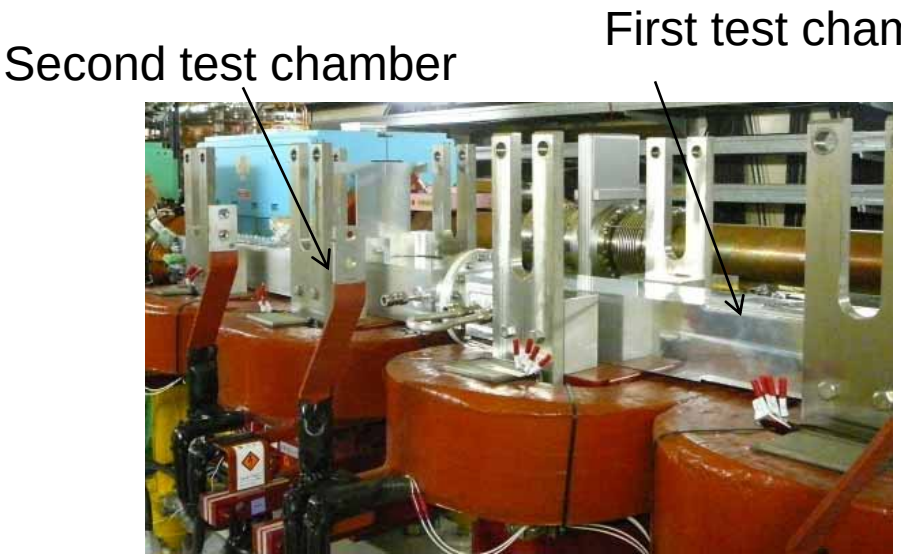
- Change of electron currents (central part) against beam does.

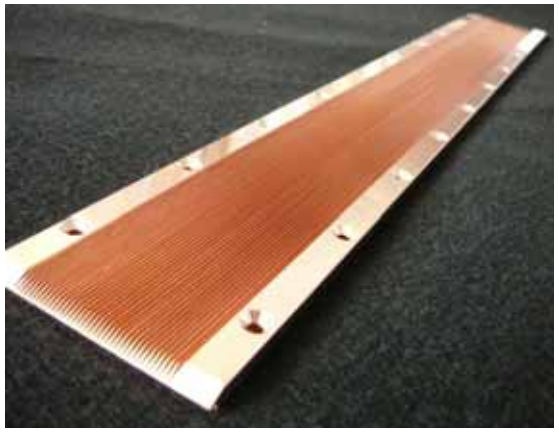


- The electron current is smaller than that for a flat surface with TiN coating by a factor of 3.
- But larger than that for a groove with β=20°, R=0.05 with TiN coating by a factor of 3.
- Electron currents are lower than that for the flat surface with TiN coating for all of grooves, even for aluminum without TiN coating.
- Smaller β and R are better.

Groove test #2

- Experiment using another test chamber with a new electron monitor with RFA.
  - Just downstream of the test chamber in the test #1
  - The structure of electron monitor was improved: smaller holes, more collectors.
- Inside of a wiggler magnet (0.78 T)
- Since 2009.

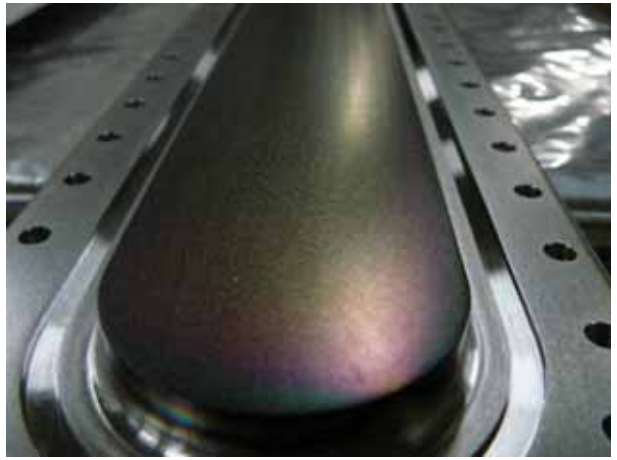




Groove test #2

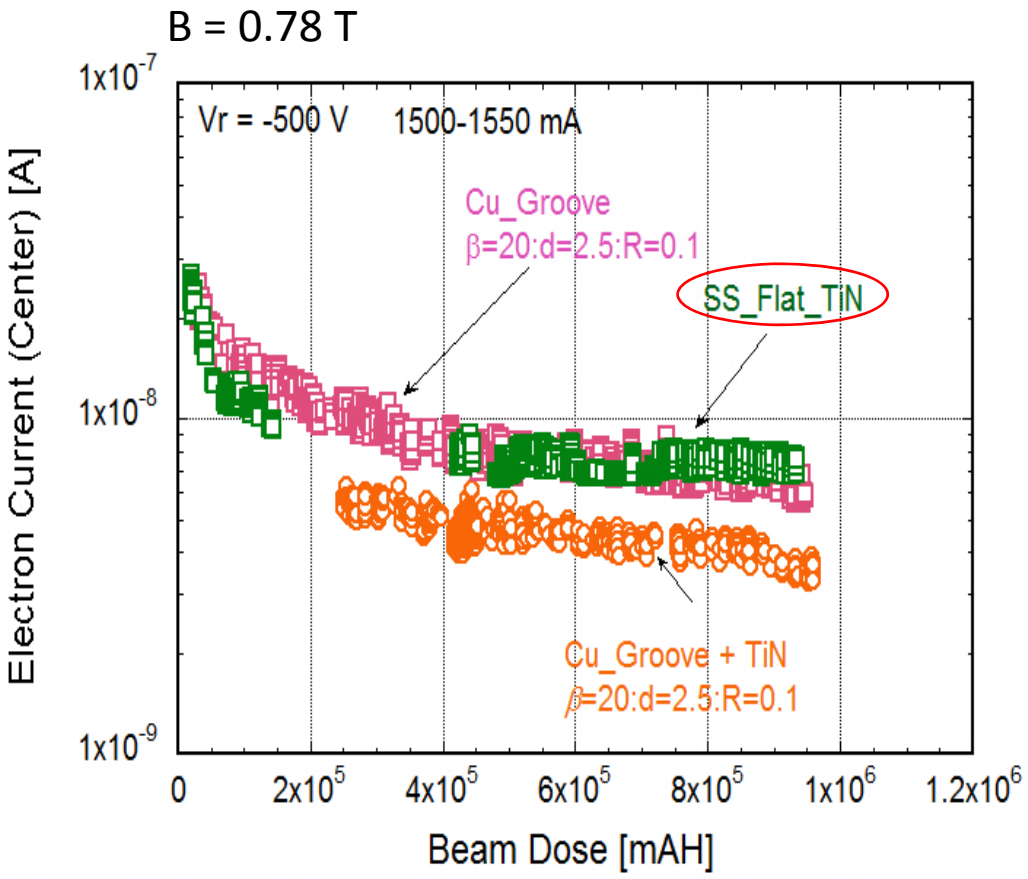
- Copper grooves with and without TiN coating have been tested here.

- In this run, a flat surface with TiN coating was tested as a reference.
  - The same surface used in the test #1 as the first sample.
  - The result can be a standard
  - for both setups, #1 and #2.
- Recently (last week), a bug in the data analysis program was fixed, and we can compare the past data at last.
- And we found a somewhat puzzling results for us ……



Groove test #2

- Change of electron currents (central part) against beam does.

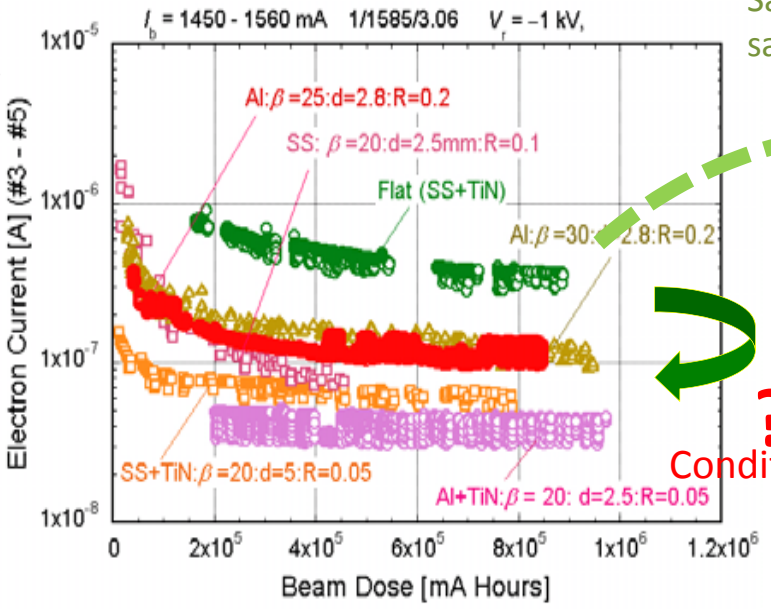


- The electron current for the flat surface with TiN coating is comparable to that for a copper groove with β=20°, R=0.1.
- But larger than that for a copper groove with β=20°, R=0.1 with TiN coating by a factor of 2.
- The results agree qualitatively to the groove test #1, **but are different quantitatively.**
  - Small values for flat TiN?
  - Large values for grooves?

Groove test #1 and #2

- What is the reason of this difference?
  - Difference of electron monitor???
  - Conditioning of samples, chambers and monitors were insufficient at the beginning of experiment?
    - The TiN-coated flat surface = The first sample in the Test #1, but the last sample in the Test #2.
    - The conditioning of copper grooves in the test #2 were still on going.

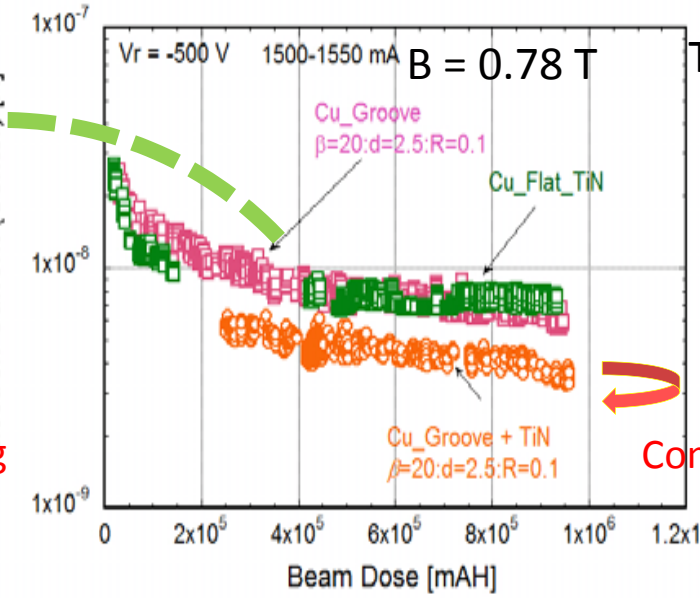
Test #1



Same sample

?

Conditioning



?

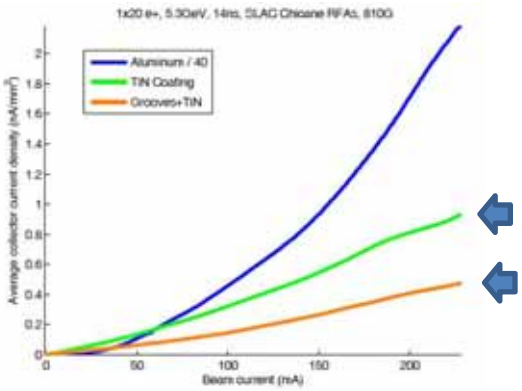
Conditioning

Test #2

Groove test #1 and #2

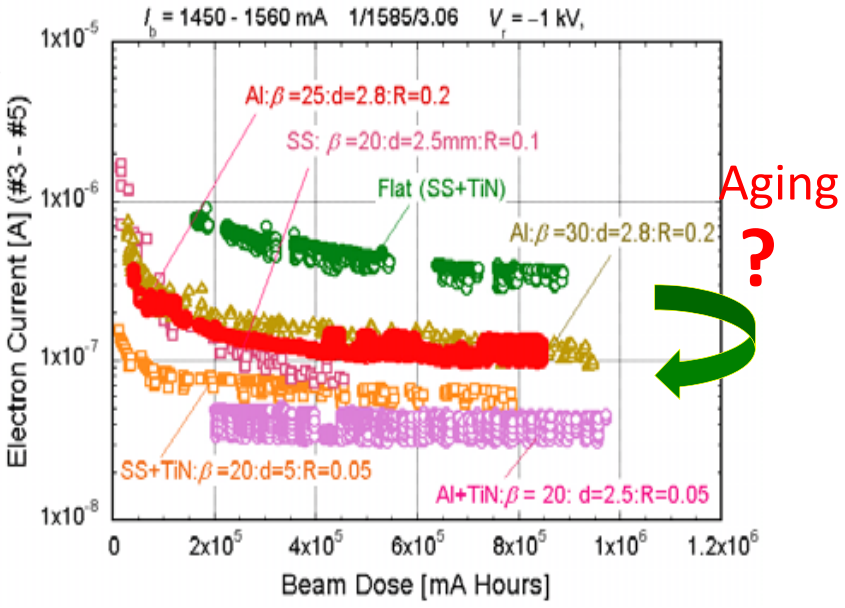
IPAC10, TUPD023

- The result in Test #2 is consistent with that in CESR-TA.
  - The electron current for a TiN-coated groove is a half of that for a flat surface with TiN (Cu).

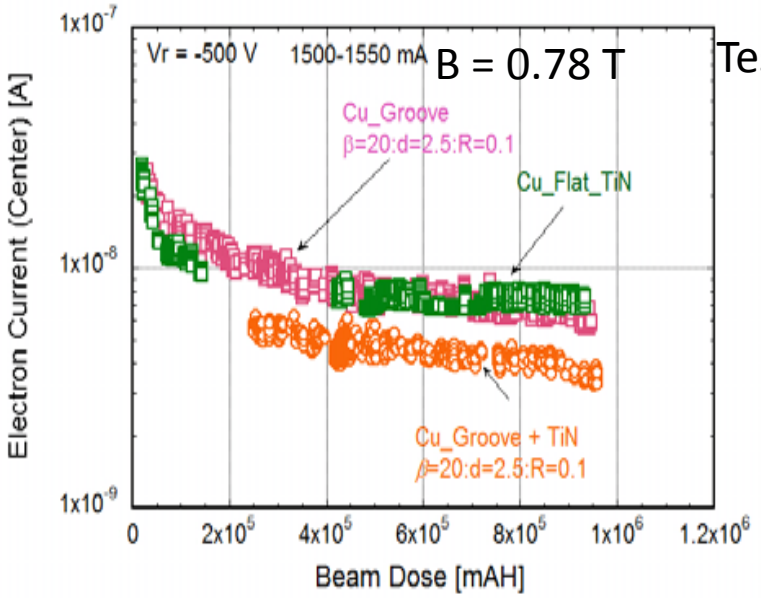


- If so, the Al grooves (w/o coating) might be not so effective as indicated in the result of test #1.

Test #1



Aging ?



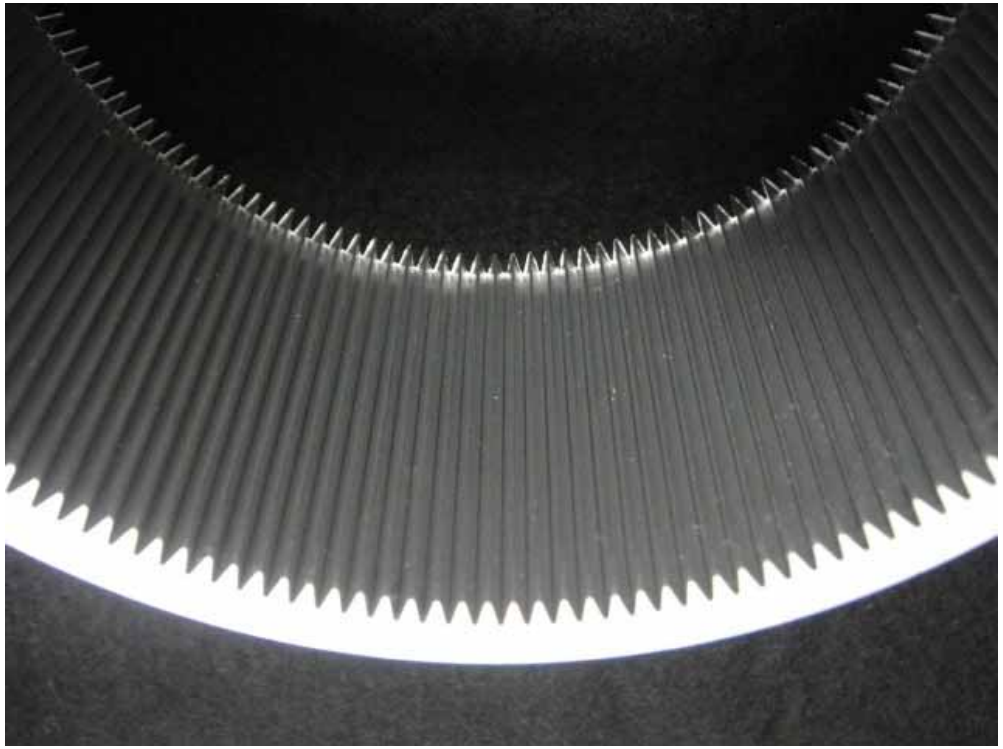
Test #2

Groove test #3

- Experiment using a test chamber with an electron monitor with RFA installed at a magnetic free region.
  - Circular beam pipe
- Since 2006.
- Copper and aluminum pipe with/without coatings, such as TiN, NEG, DLC, have been tested.

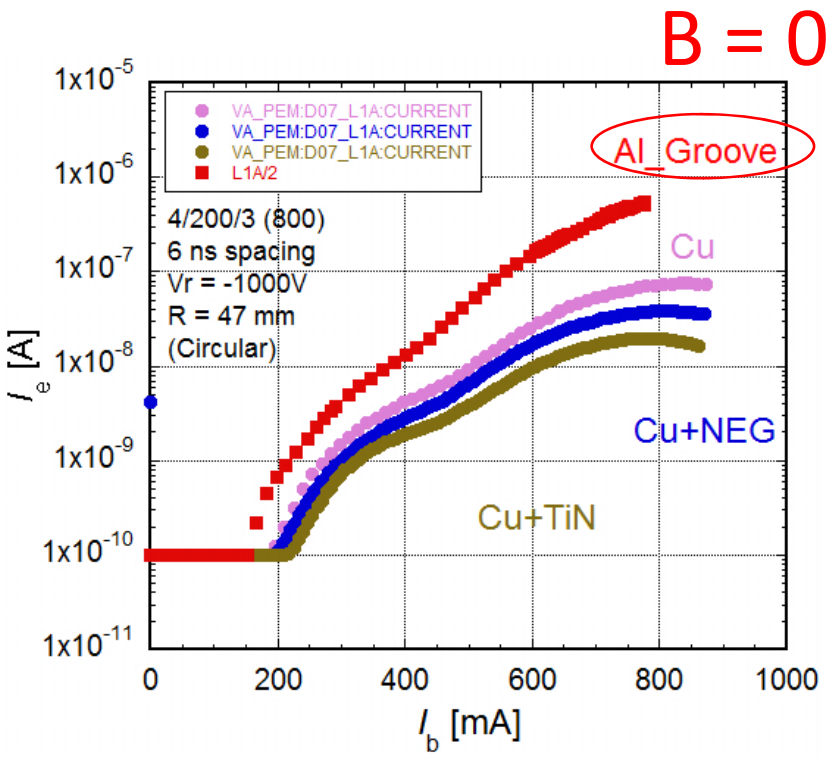
Groove test #3

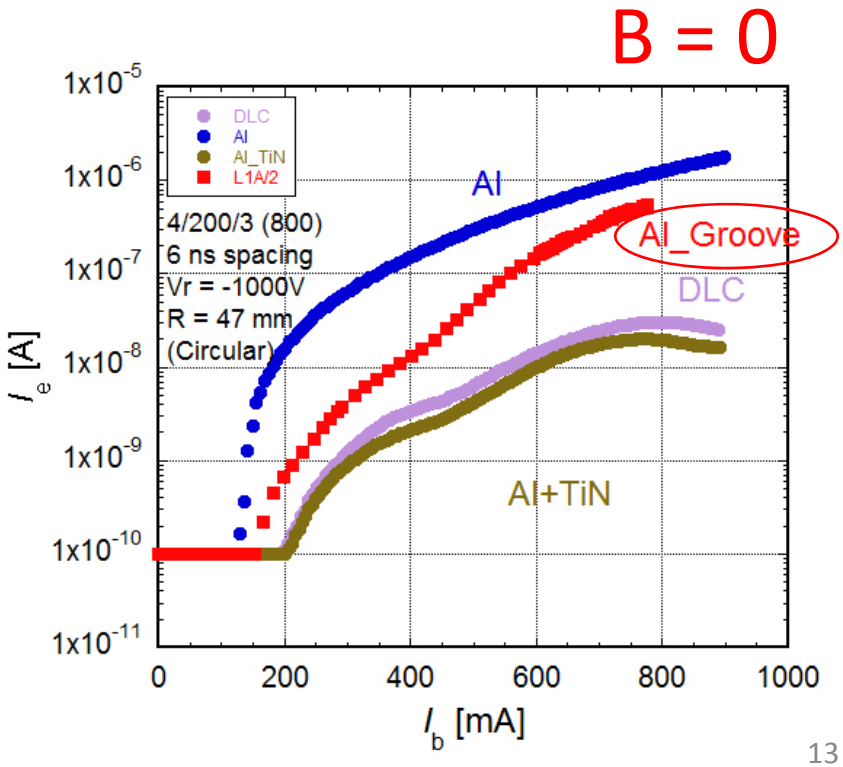
- In this run, an aluminum groove with β = 25 °, d = 2.8 mm and R = 0.2 mm, considering the mass production by the extrusion method.
  - The same structure used in the test #1.



Groove test #3

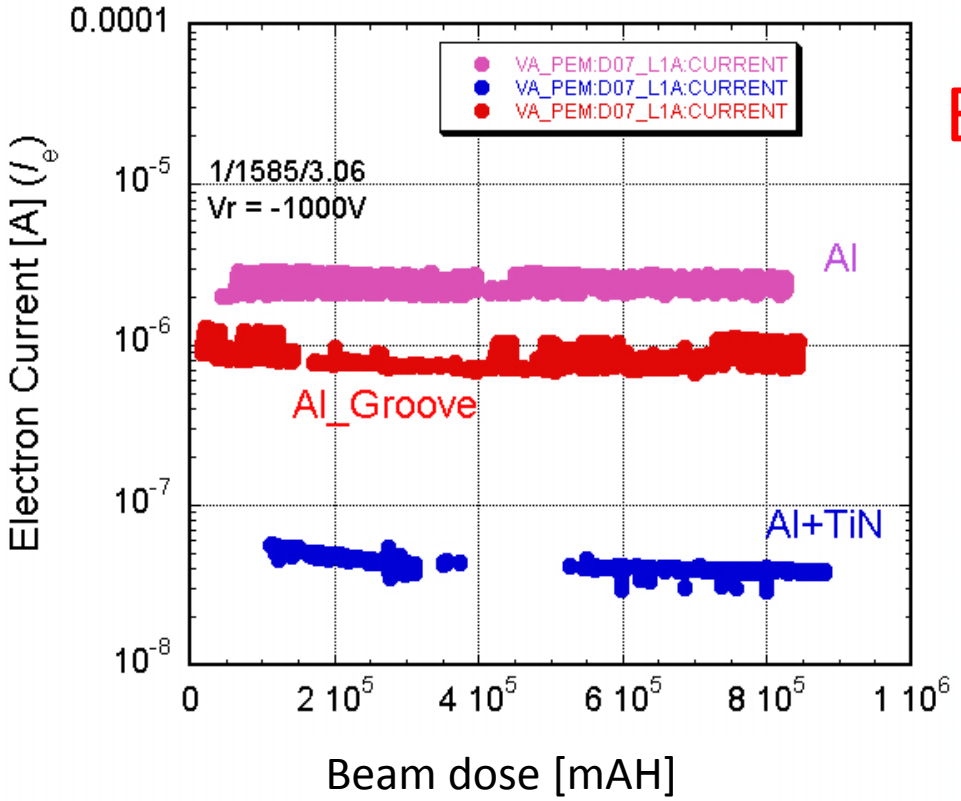
- Electron currents vs. beam current
- The electron current for the groove is smaller that that for a flat Al surface by a factor of 2, but much larger than that for a flat Cu surface.
- More effective at low beam current regime?.





Groove test #3

- Change of electron currents (central part) against beam does.
- Triangular grooves are more effective in a dipole magnetic filed than in a magnetic free condition??
  - Need further investigation.



B = 0

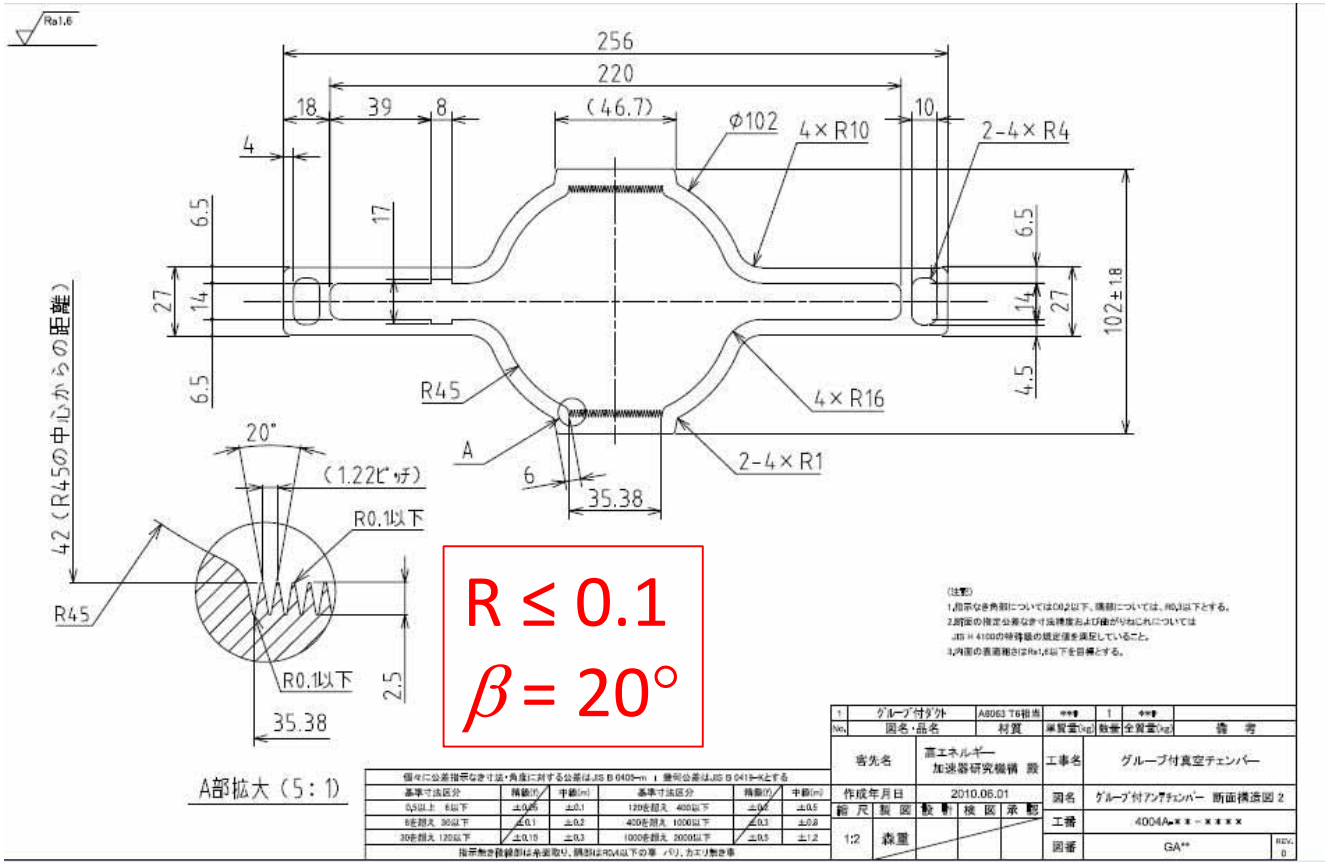
Summary

Groove

- Somewhat puzzling results were obtained in the second experiment in the same magnetic field.
  - Insufficient conditioning for the early samples (and monitors?) can be a reason of the difference.
- We have to be careful for the effect of aluminum grooves. (TiN coating is indispensable in magnetic-free condition at least)
- More experiments are required about SEY of grooves in a magnetic filed.

R&D plans this year

- Extrusion of Al beam pipe with sharper grooves.



- Measurement of SEY in magnetic field.