

# **Coupler fabrication for low-beta cavities**

TTC Meeting at CEA-Saclay 6 July, 2016 Masao IRIKURA

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## 1. Recent delivered SC prototype couplers(1)

ESS(CEA-Saclay)



https://europeanspallationsource.se/accelerator





## 1. Recent delivered SC prototype couplers(2)

### • RISP QWR



#### ECR-IS (10keV/u, 12 pµA) Driver Linac Post Acc. Cyclotron LEBT RFQ (300keV/u, 9.5 puA) 128.5m O+8 Xe+54 U+79 Particle H+ RI beam proton Beam energy(MeV/u) 600 320 251 200 18.5 70 Beam current(pµA) 660 78 11 8.3 1000 -400 400 400 400 Power on target(kW) \_ 70 100m SCL1 (18.5 MeV/u, 9.5 puA) Driver Linac Chg. Stripper SCL2 (200 MeV/u, 8.3 pµA for U+79) (600MeV, 660 µA for p) 375m 100n 80m ISOL 70m 20m Target MEBT RFQ HRMS uSR, Medical **RF** Cooler Cyclotron IF Target 250m SCL3 (p. 70 MeV, 1mA) Atom/Ion Trap IF Separator ECR-IS Gas Catcher Post Accelerator ISOL system 110m IF system 100m CB : Charge Breeder HRMS : High Resolution Mass Separator Low Energy High Energy Experiments Experiments Nuclear Structure/ Nuclear Astrophysics Symmetry Energy Material Science **B-NMR**

**Rare Isotope Accelerator Conceptual Diagram** 

http://www.risp.re.kr/eng/orginfo/intro\_project.do

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## **1. Recent delivered SC prototype couplers(3)**

### • FRIB HWR







http://epaper.kek.jp/SRF2011/papers/mopo009.pdf

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## 2. Equipments for coupler production(1)

### **Clean room for manufacturing couplers**





## 2. Equipments for coupler production(2)



**Ultra-pure water generator** 



#### **Ultrasonic bath**



#### Sink for rinsing



Leak detector and auxiliary vacuum system



#### **Baking systems**

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## 3. Technical improvement(1)

### **Improvement of copper plating**

- Heating processes after copper plating sometimes gave many blisters on cylinder and bellows of outer conductors. Investigations was made with KEK and our subcontractor.
- The relation with plating solution became clear. The subcontractor is controlling a parameter.



Many large blisters on the inner surface after heating



Normal surface after heating



## 3. Technical improvement(2)

### **Improvement of brazing**

- Ag-Cu brazing alloy was sometimes found oozing through brazing joint on RF surface.
- We try to control the amount of the brazing alloy, but it's difficult to avoid because it is affected by variation in smoothness of copper part and copper plating, brazing temperature, content of brazing alloy and so on.



Oozed brazing alloy



No oozing



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## Summary

- TETD delivered prototype couplers for ESS(CEA-Saclay), IBS/RISP and MSU/FRIB in 2015 2016.
- TETD introduced a clean room and some equipments for coupler production.
- Some technical improvements was made in our prototype coupler production.
  - Blisters on the copper plating after heating is found to be related to plating solution, and our subcontractor is controlling a parameter successfully.
  - Oozing of brazing alloy is unavoidable, but we keep on trying to avoid oozing it by controlling the amount of brazing alloy and other conditions.

### TETD will start manufacturing FRIB HWR couplers in this summer.

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