

Update of Vertical Electro-Polishing Studies at Cornell with KEK and Marui Galvanizing Co. Ltd

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Introduction

Cornell, KEK, and Marui Galvanizing Co. Ltd have started Vertical Electro-Polishing (VEP) R&D collaboration in 2014 to improve the removal uniformity. MGI and KEK have developed their original VEP cathode named i-cathode Ninja®, which has four retractable wing-shape parts per cell. One single cell cavity, NR1-2, has been processed with VEP using the i-cathode Ninja at Cornell. Cornell also performed the vertical test on that cavity. We present the details of the process and RF test results at Cornell.

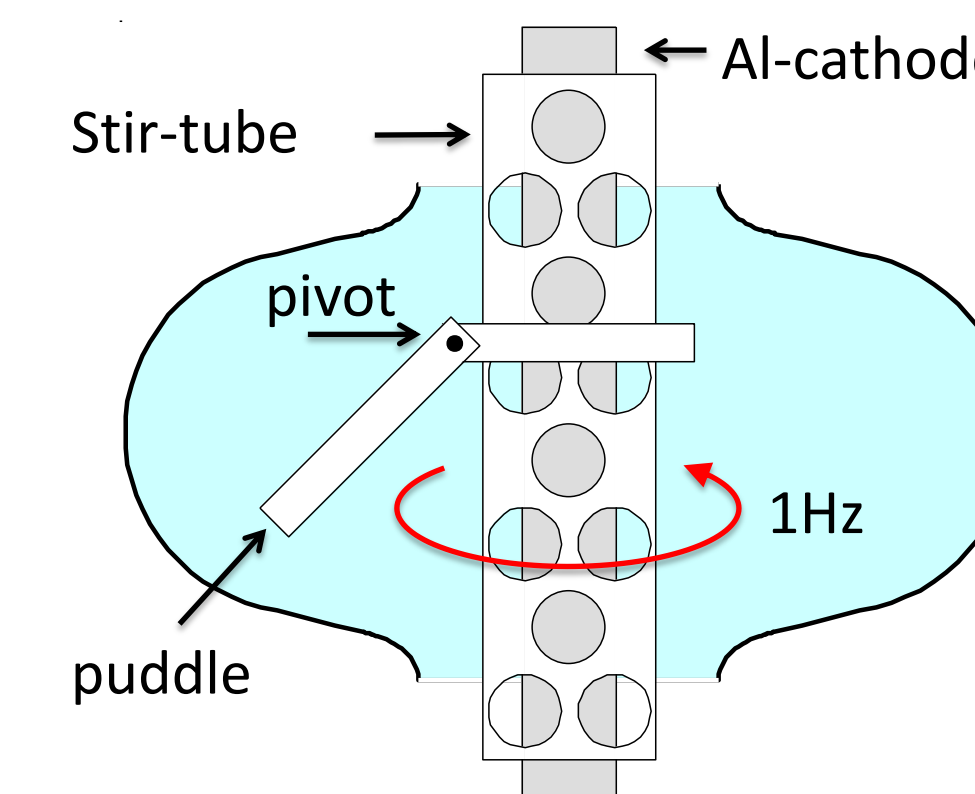
Installation of "Ninja"-cathode into Cornell VEP system

- Two type of Ninja-cathodes and top/ bottom EP sleeves were provided from Marui.
- Upgraded the acid tubing to make acid circulation during VEP.
- EP control system, acid tank, circulation pump, water cooling, I-V source, were used without any changes.

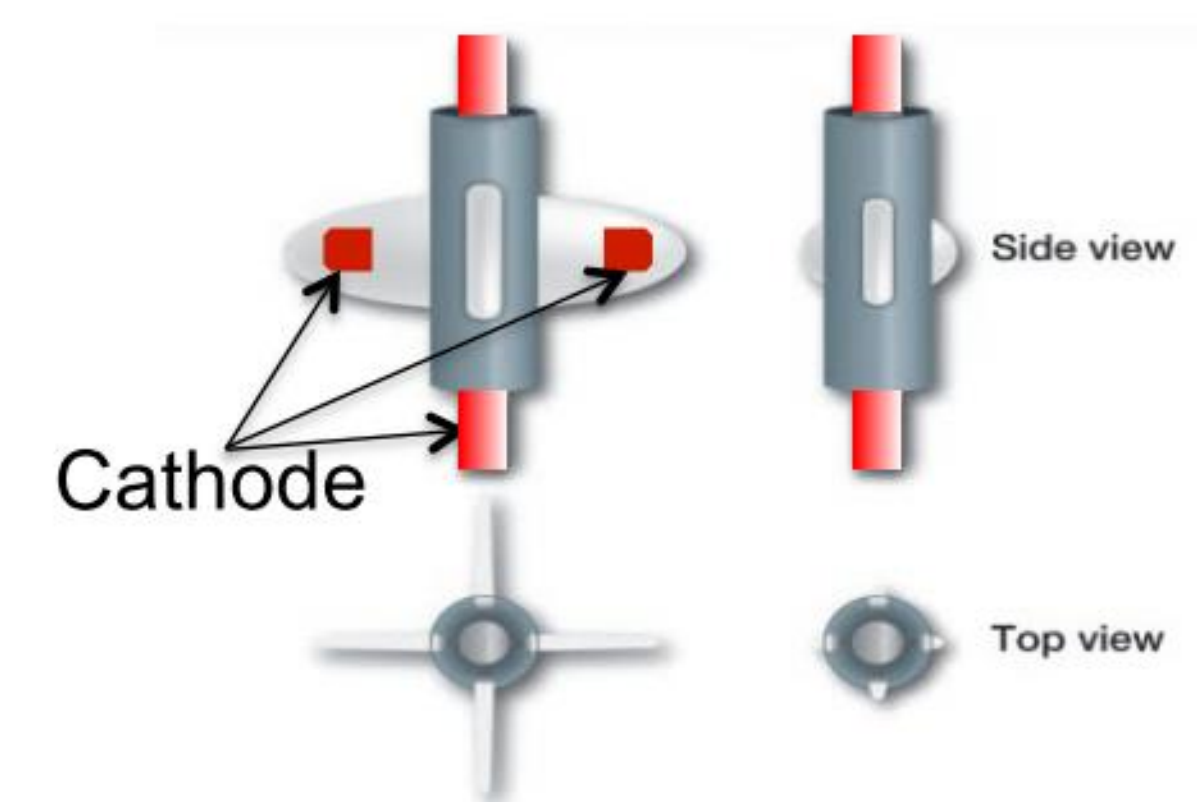
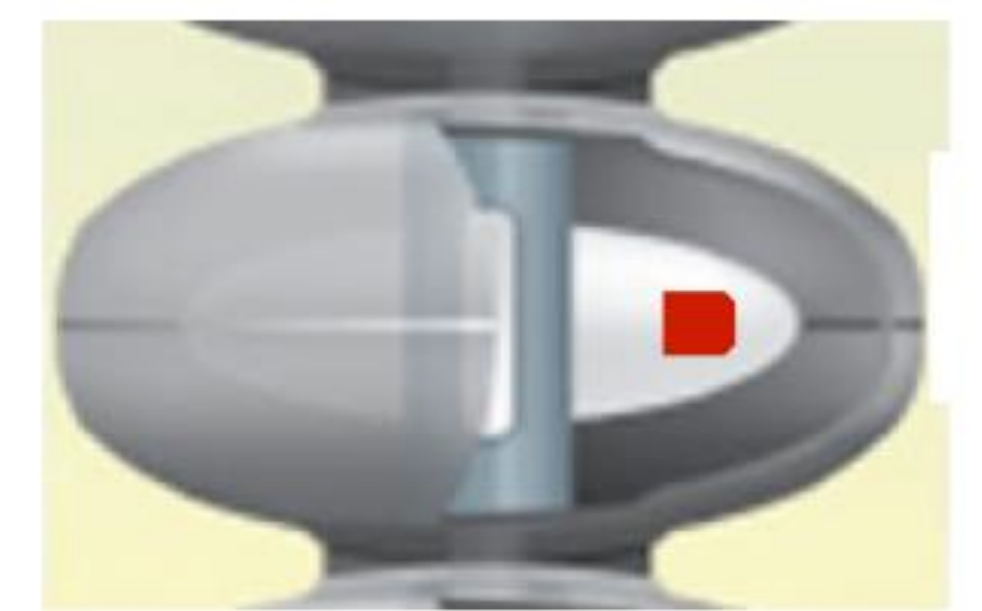


Images of VEP cathode

Cornell cathode



"Ninja" cathode type-1



Retractable wing on cathode

VEP parameters and results at Cornell

Parameter comparison	Cornell	KEK-Marui		
		Ninja type-1	Ninja type-2	
Electrolyte composition	9:1 (H ₂ SO ₄ : HF in weight)			
Voltage	14Volts	14Volts	14Volts	
Current ave. (single cell EP)	~17Amps.	~22Amps.	~29Amps.	
Temp. (cavity outside)	17~18degC	20~25degC	20~25degC	
Acid circulation	None	~5L/min.	~5L/min.	
Agitation speed	0~1Hz	0.8Hz	0.8Hz	
Puddle type /cell	1 Teflon puddle	4 Teflon wing w/ Al	4 Teflon wing	
Teflon cathode bag	Yes	None	Yes	
Removal* (preliminary)	target	20um		
	Top half	24um	36um	29um
	Bottom half	14um	20um	18um

- Target removal was calculated from the current integration during the process.
- Measurements on top/bottom half cell was done by ultra-sound thickness gauge after the process.

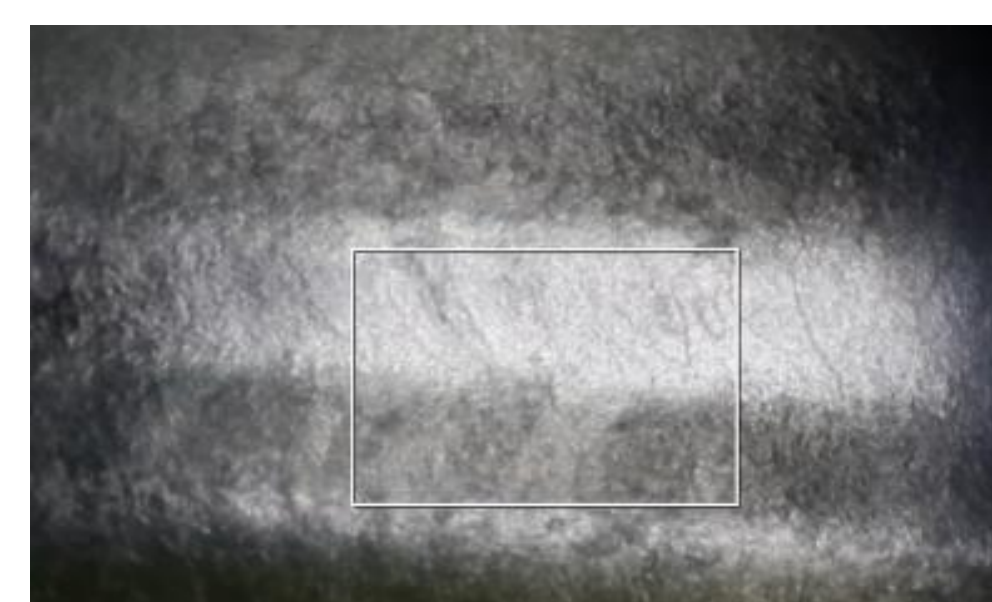
Process notes for VT

Step	Surface preparations
1. VT post Cornell VEP	Bulk VEP (120um)+ degas + light VEP (20um)+ 120C*48hrs baking
2. Reset surface	Tumbling (40um) + BCP(60um) + degas (800C*2hrs)
3. VT post Ninja VEP	+ VEP (20um) w/ Ninja cathode type-1 + VEP (20um) w/ Ninja cathode type-2 + 120C*48hrs baking.

Optical inspection images of equator weld seam on RF surface



Cornell cathode
VEP 120um+20um

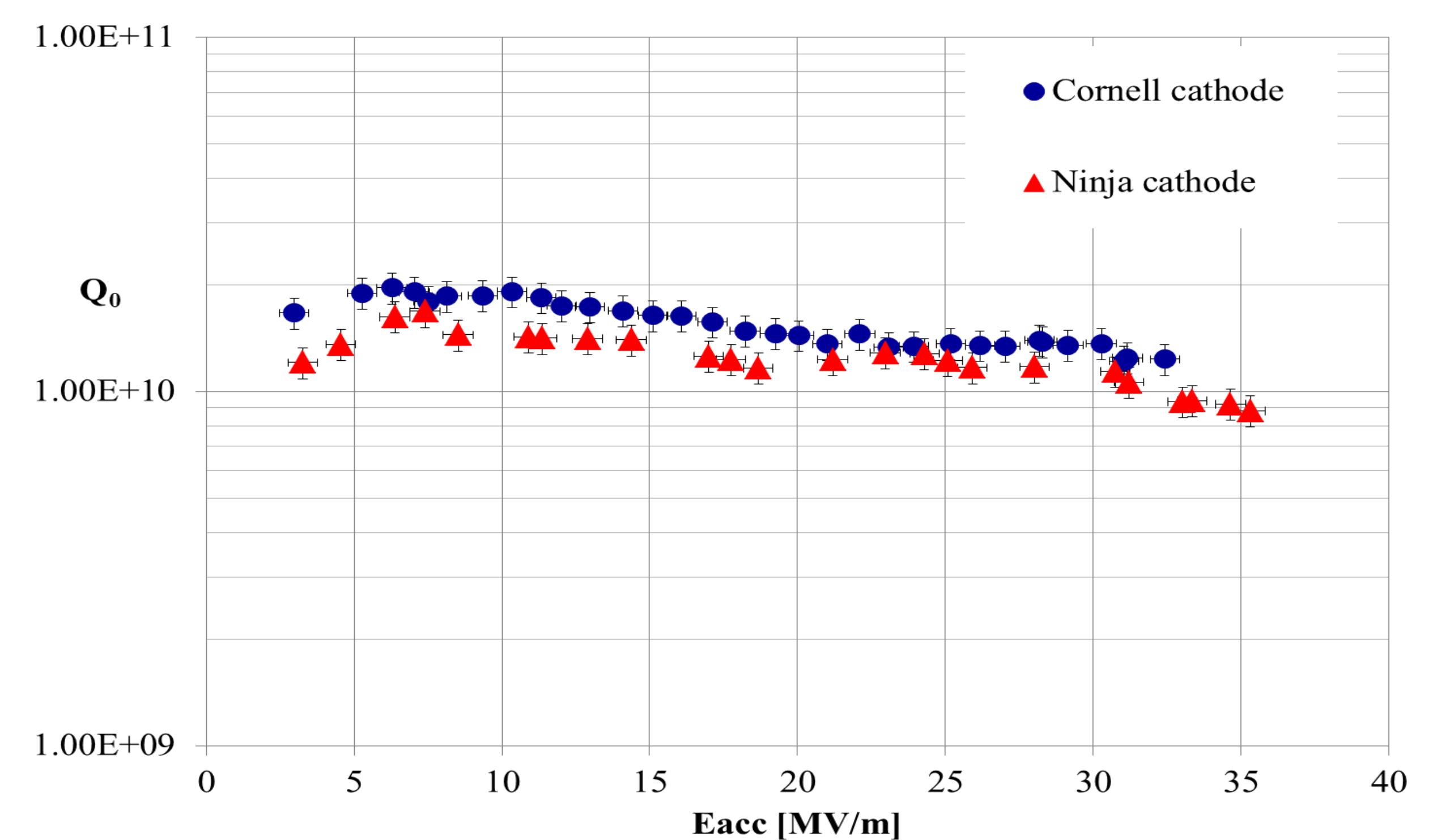


Ninja type-1
BCP60um + VEP20um



Ninja type-2
+ VEP20um

VT results at 2K



- Both tests were limited by quench, field emission free.

Summary

- The integration of the Ninja cathode into the Cornell VEP system and VEP process had been done successfully at Cornell.
- This is the first trial to use Ninja cathode at Cornell. The parameters were set based on Marui's experiments, but not optimized for Cornell's system yet.
- Similar defects or features were seen on both surfaces after Cornell and Ninja VEP by optical inspection.
- RF test on single cell processed with Ninja cathodes was performed. The result was good and comparable to Cornell VEP.
- The development of a 9-cell scale Ninja cathode and a parametric study of removal uniformity for 9-cell is in progress at Marui and KEK. The 9-cell process with Ninja cathode at Cornell is planned for the future.
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