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Preparation and characterization of non-evaporable Ti–Zr–V getter films for HEPS

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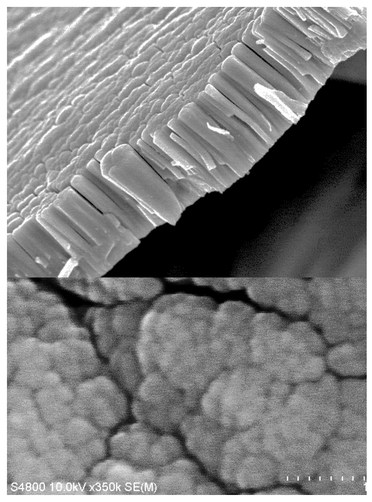
Abstract: For the low activation temperature and high pumping speed, surface pumping capacity, the TiZrV coatings were chosen to high energy photo source (HEPS). Films of TiZrV alloy have been deposited on 1.5 meter long, cylindrical vacuum chambers of 22mm diameter copper substrates in krypton ambient using DC magnetron sputtering system. Film composition, the activation temperature and pumping properties have been investigated in order to optimize the deposition parameters for vacuum applications.

Coating Procedure Optimization

Non-evaporable getter (NEG) film coatings have been developed at IHEP to provide linear pumping for vacuum chambers of limited conductance. One facility for 1.5m and 250mm pipe was constructed. The cathode was made by twisting three wires of high-purity (99.95%) titanium, vanadium and zirconium, each of 1 mm diameter. The solenoid is powered by a DC power supply, providing a desired magnetic field about 200 G.



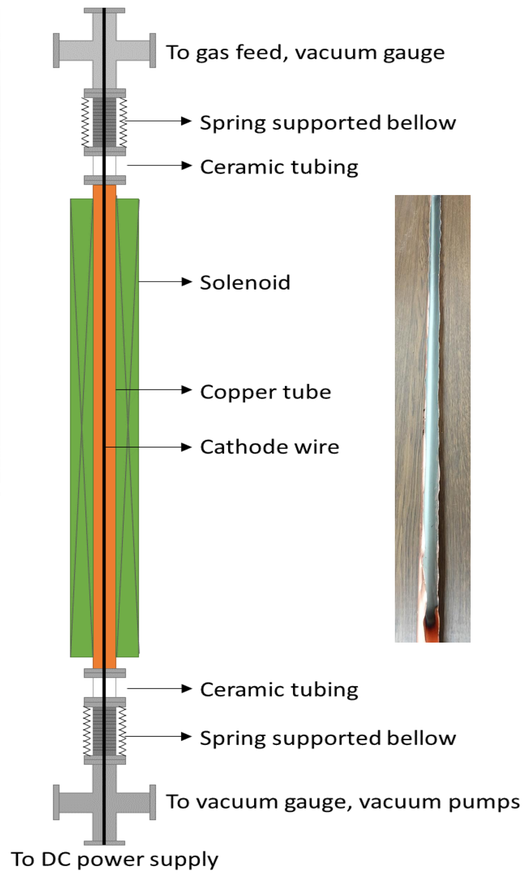
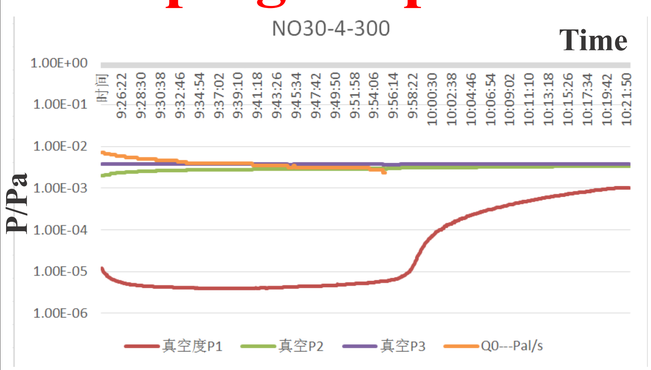
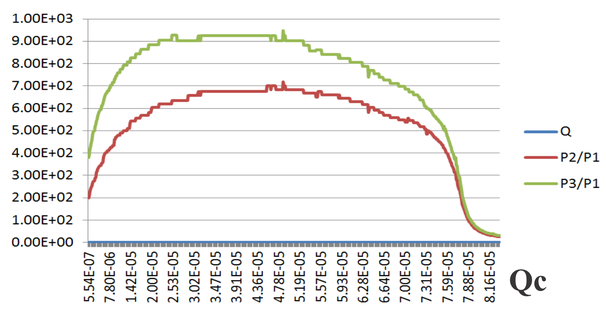


Figure1. facility of NEG coating

No. run	coating parameter: Ti:V:Zr (Hf)	Before coating/Pa	Kr/Pa	U/ V	I /A	Cu tube Temp.	composition (RBS): Ti	V	Zr	O	HF
No.19	1:1:1	1.40E-06	24	208	0.26	120	20%	58%	12%	10%	
No.20	1:1:2	1.50E-05	25	185	0.26	80	3%	3%	60%	34%	
No.21	1:1:2	4.10E-07	23	193	0.26	80	10%	12%	68%	10%	
No.22	1:1:1	1.60E-06	24	215	0.26	100	20%	58%	12%	10%	
No.23	1:1:1	7.70E-07	24	216	0.26	80	37%	50%	10%	3%	
No.24	1:1:1	4.00E-07	24	220	0.26	80	24%	65%	9%	2%	
No.25	1:1:1:1	6.60E-07	24	198	0.26	100	26%	22%	20%	1%	31%

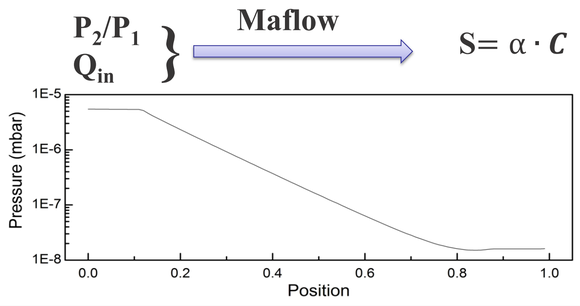
Pumping Properties

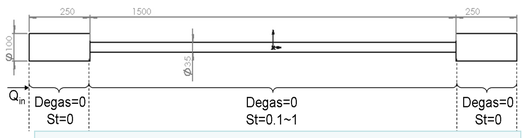




$$Qc = \int C \cdot (P3 - P2)dt$$

No. run	Test gas	capacity	Vacuum Ratio of two sides	
		mbar.l/cm²	P2/P1	P3/P1
NO30-4-300	CO	8.32E-05	717.9	948
NO30-5-180		7.36E-05	1454.0	2636
NO30-6-180		6.67E-05	1200.0	2125
NO30-7-250		7.78E-05	1333.3	2600
NO30-9-250	H2	2.75E-03	220.0	220





Qin = 3.32E-05 mbar.l/s

sticking factor	P1 (mbar)	P2 (mbar)	ratio
0.004	5.22E-06	1.24E-08	421.7
0.005	4.71E-06	6.03E-09	781.7

Ion gauge: GP350
CO、H2 purity：4N5
Orifice：2~6mm

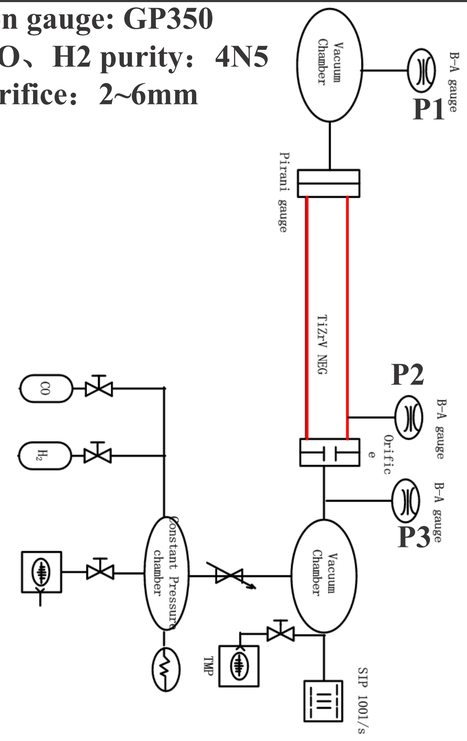
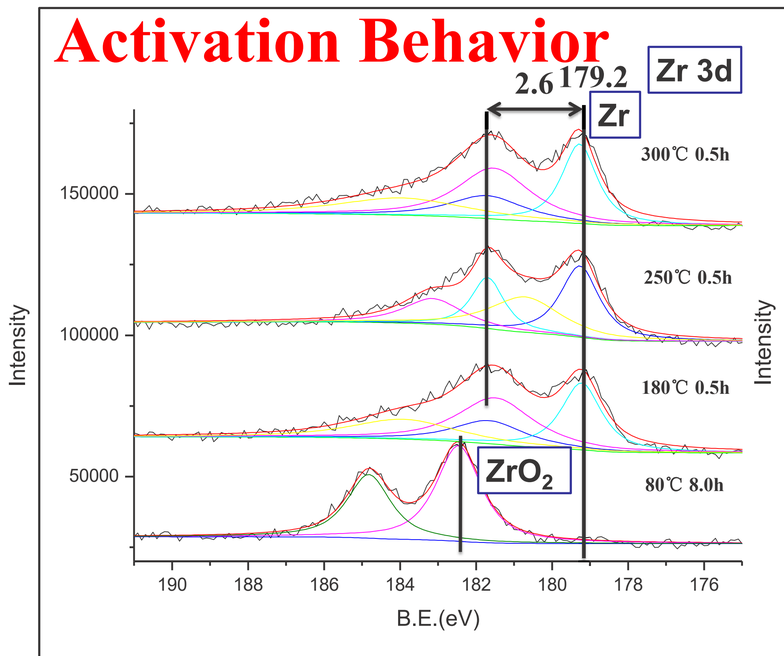
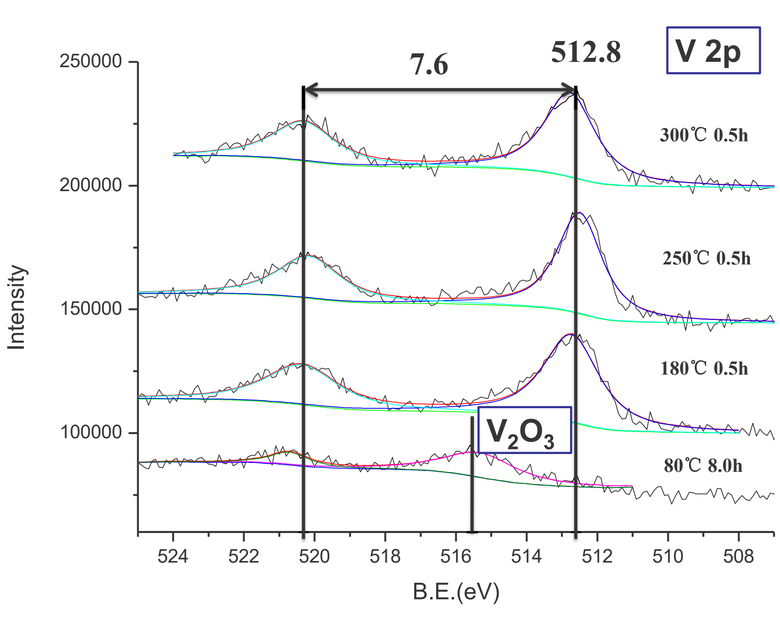
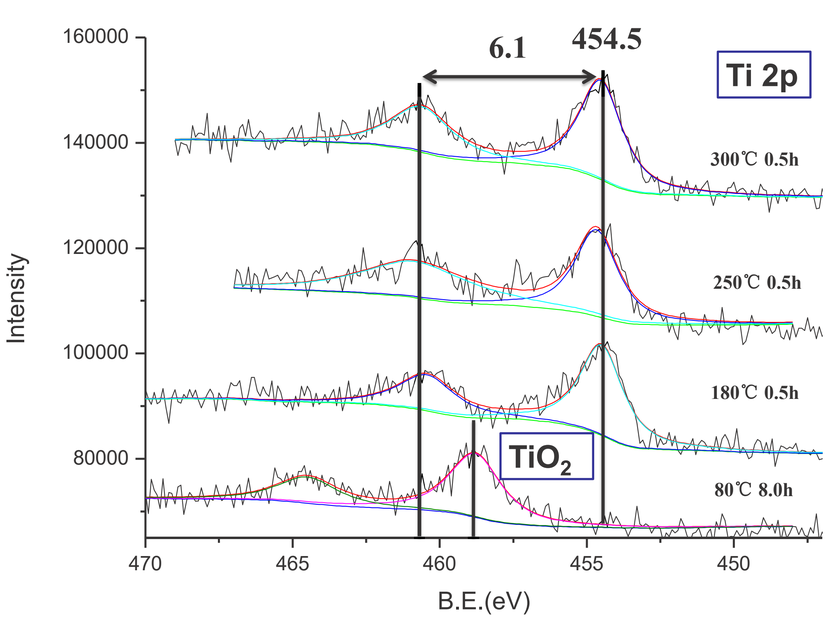


Figure2. pipe pump speed Test

Activation Behavior







Totally activated at 180℃

Next work

- The NEG coating processing is on the way of regular
- We are struggling to improve the CO pumping speed test procedure

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Vacuum Group
Accelerator Center

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