

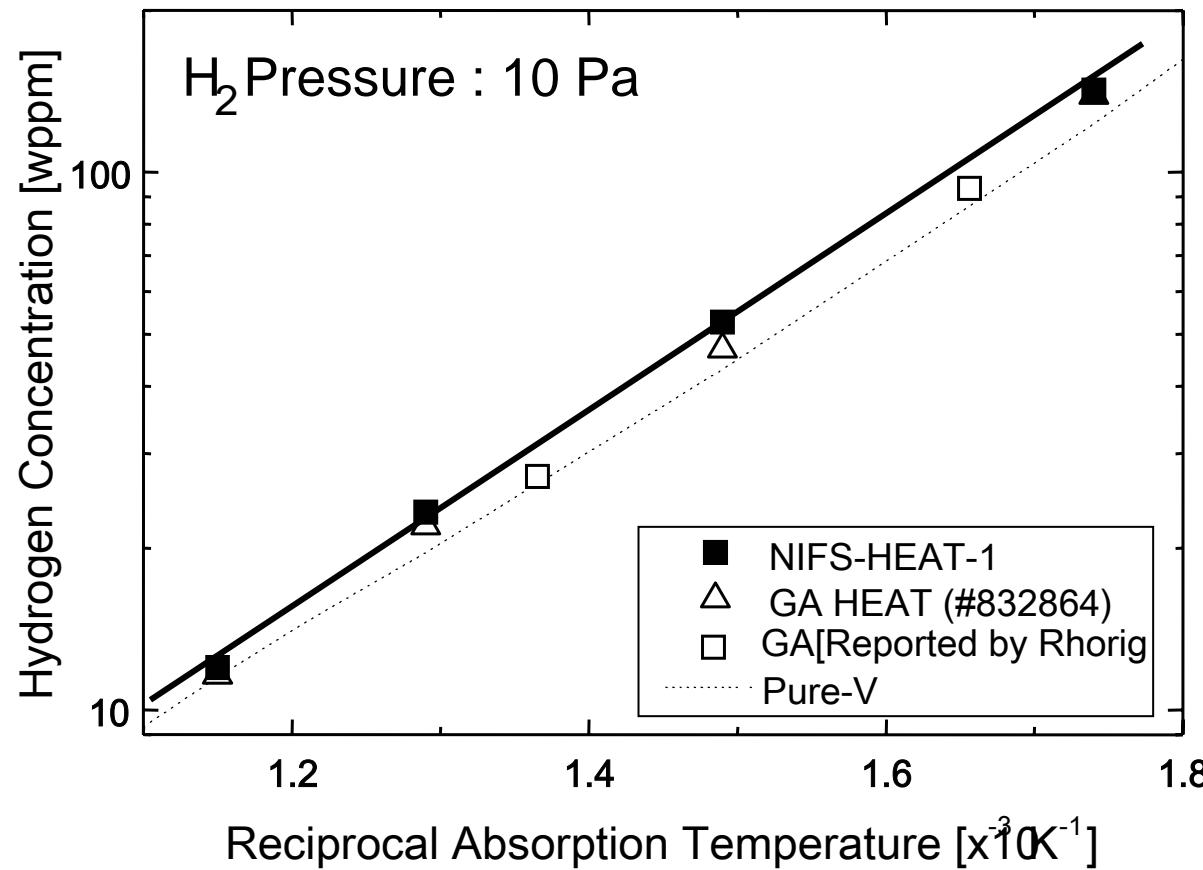
Reduction of Hydrogen Absorption of Vanadium Alloy by Titanium Oxide Coating

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Purpose

- Hydrogen embrittlement takes place when
 - 〔 H conc. > 400 wppm (pure V-alloy)
 - 〔 H conc.> 35~160 wppm (Oxidized V-alloy).
- Method to reduce hydrogen absorption is required.
 - 〔 Ti-O coating was tried.

Hydrogen concentration of V-metal and V-alloy



H conc. of V-alloy is similar to that of V-metal.

Experiments

Sample

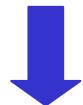
NIFS-HEAT-1 V-4Cr-4Ti alloy

Chemical composition of NIFS HEAT-1 after heat treatment at 1273 K for 2 hr (wt.%)

Cr *	Ti *	C	N	O	H	Si	Nb	Mo	Fe
4.4	4.1	67	88	181	18	200	<100	<100	200

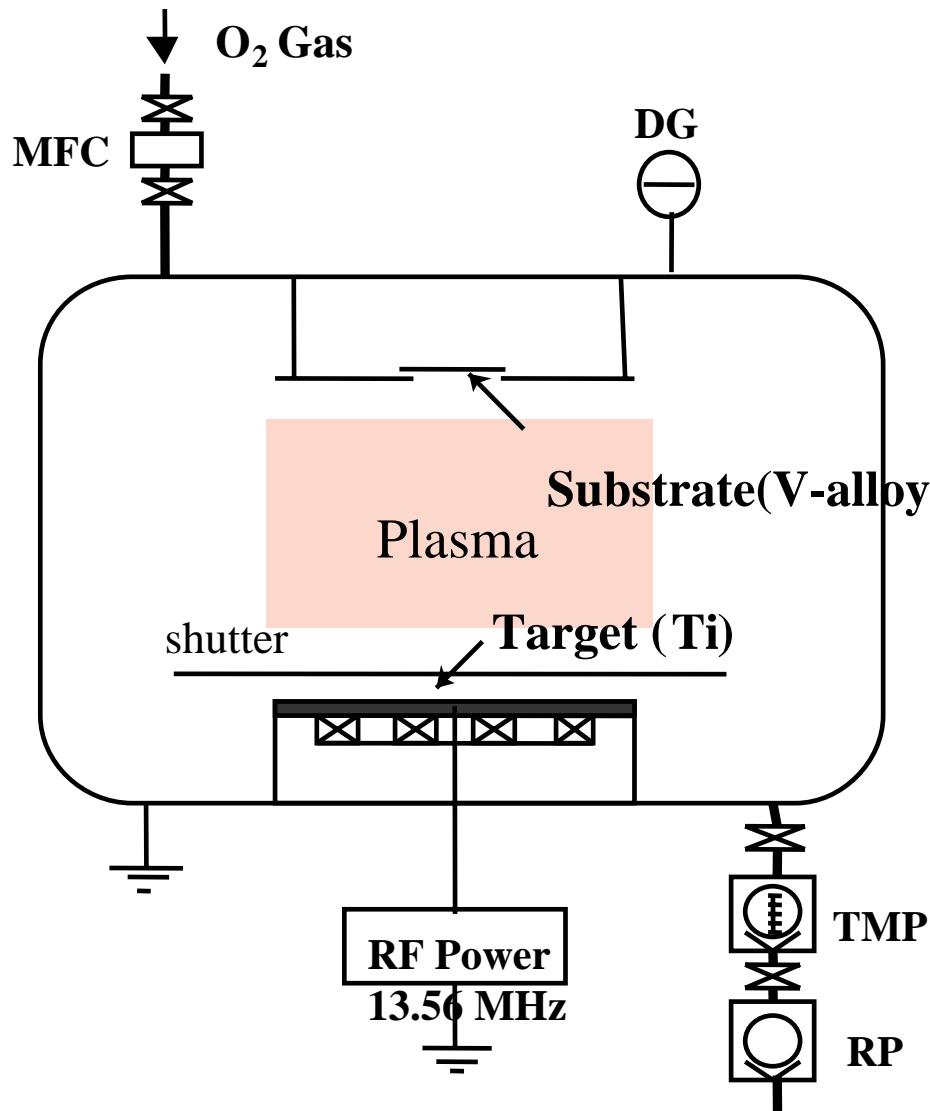
As a reference: GA HEAT (#832864)

Sample size: slab sample (10 mmx10 mmx1mm)



Mechanical Polishing & Pre-baking(1273 K, 2 hr)

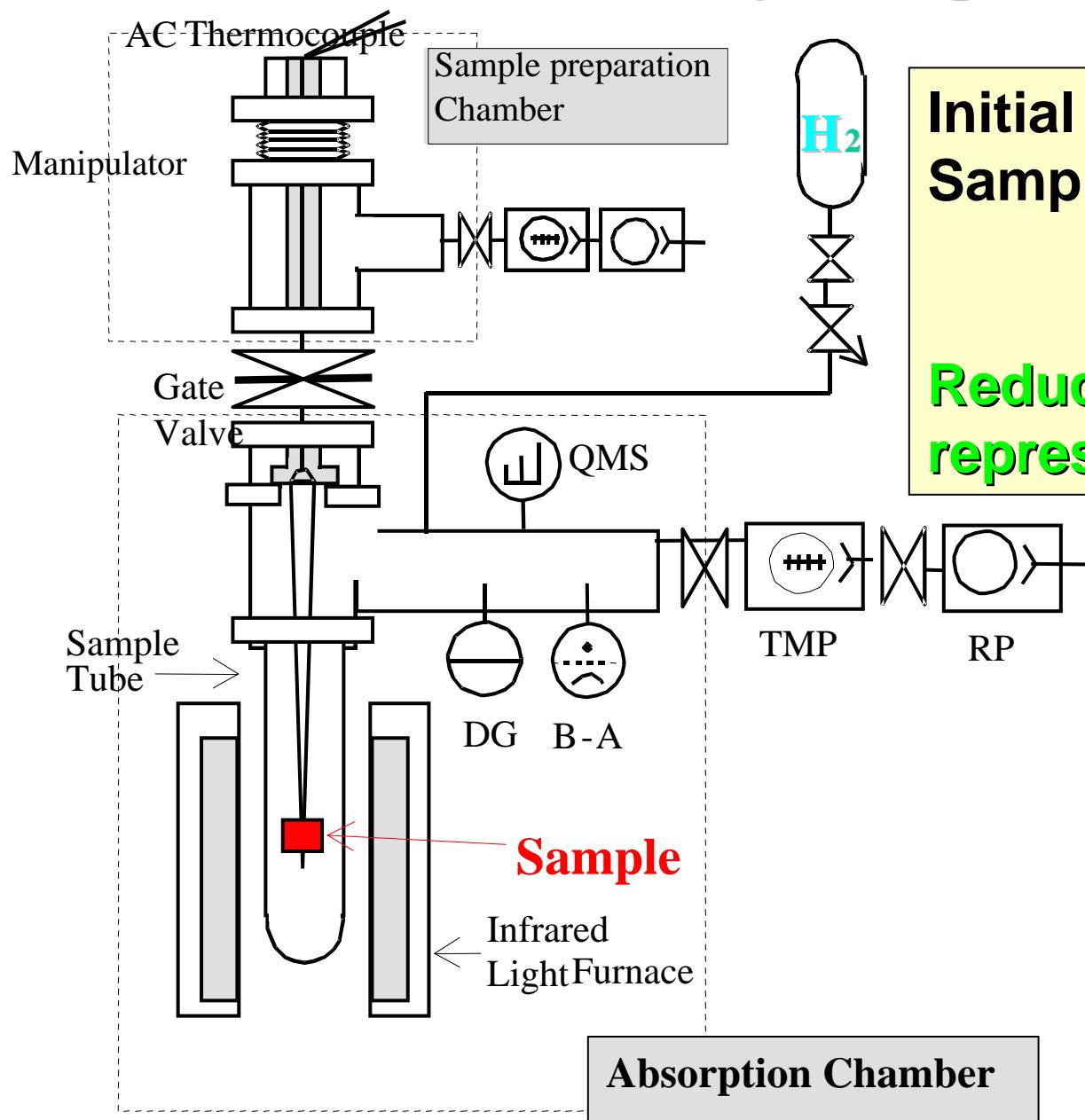
Ti-O coating



Discharge Gas: O_2
Target: Ti

Thickness of Ti-O film
0.13~1.1 μm

Measurement of hydrogen absorption



Initial gas pressure : 40 Pa
Sample temperature: 573 K

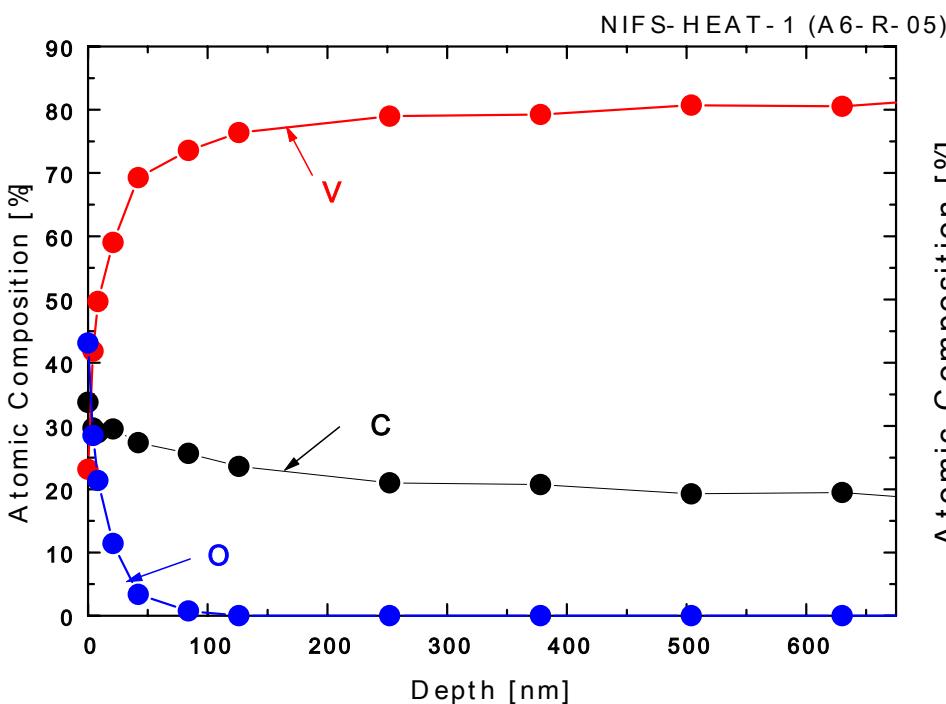


**Reduction of gas pressure
represents absorption amount.**

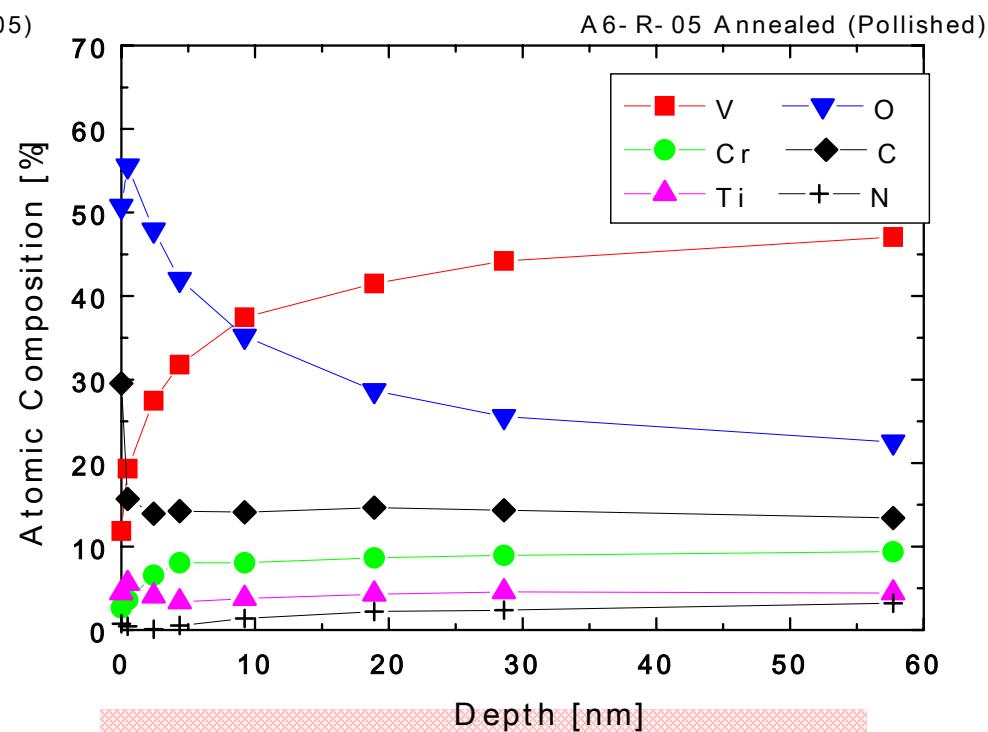
Results and Conclusion

(1) Depth profile before coating

a) AES analysis



b) XPS analysis

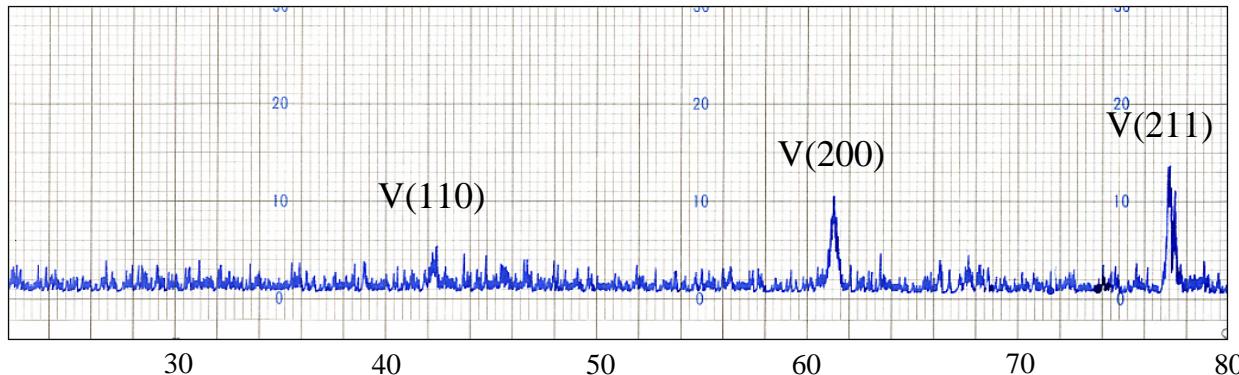


$C \rightarrow VC$

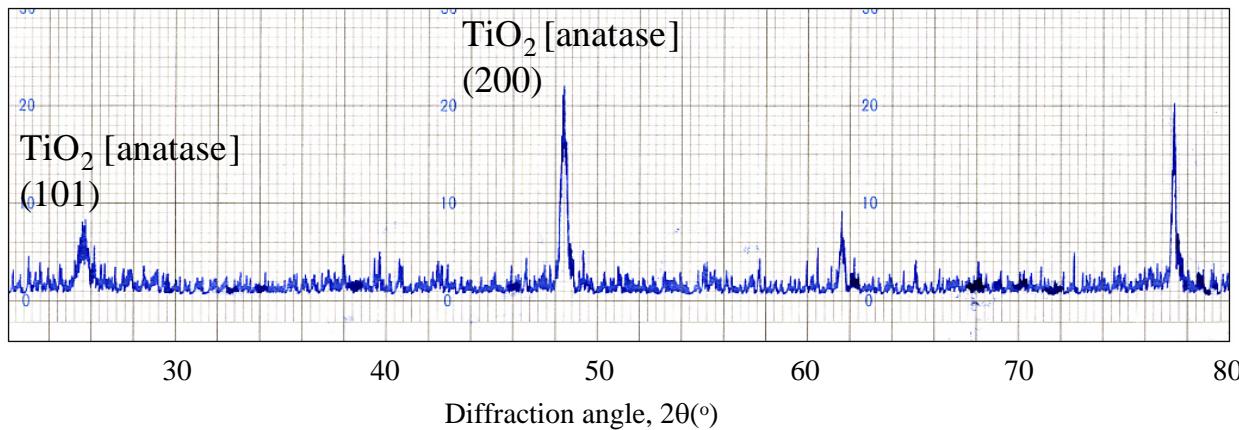
Ti, Cr → several %

(2)Crystal structure

V-alloy after heating at 1273 K for 1 hr



Ti-O coated sample

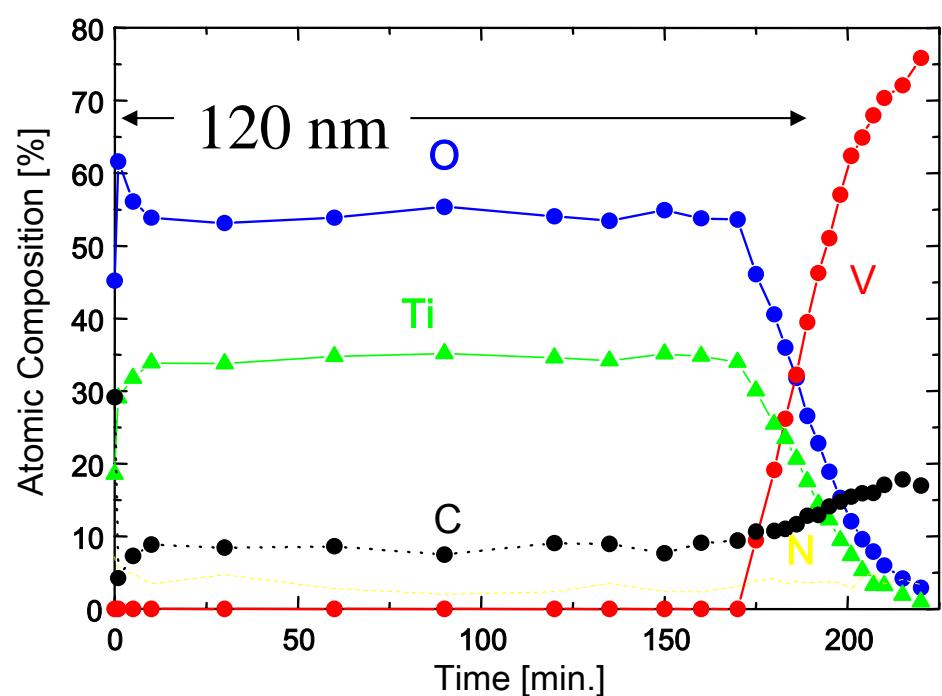


Most of structure $\rightarrow \text{TiO}_2$

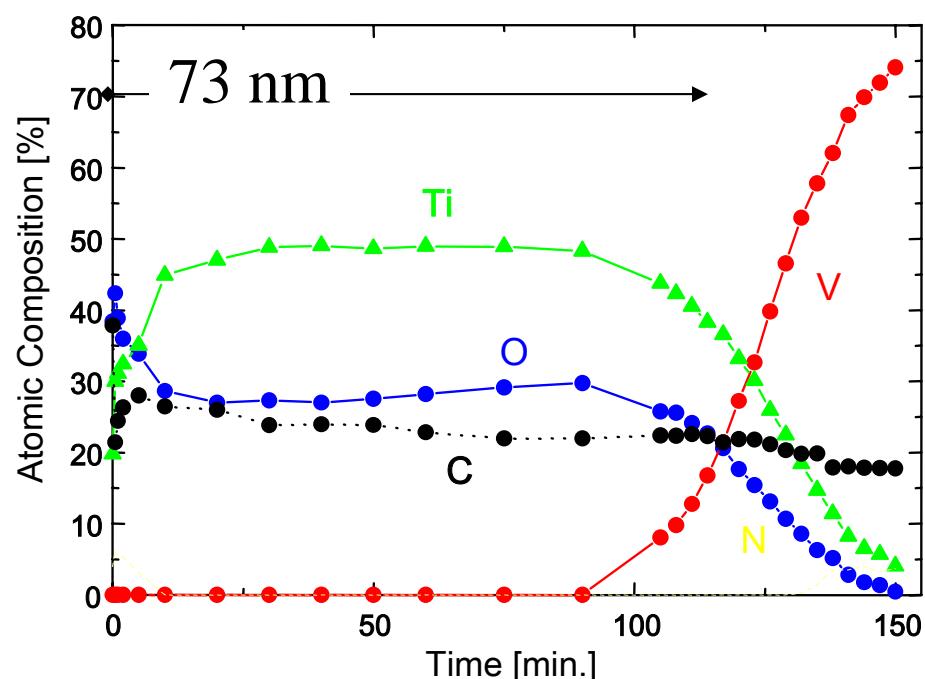
(3) Change of film thickness and atomic composition by heating

Depth profile

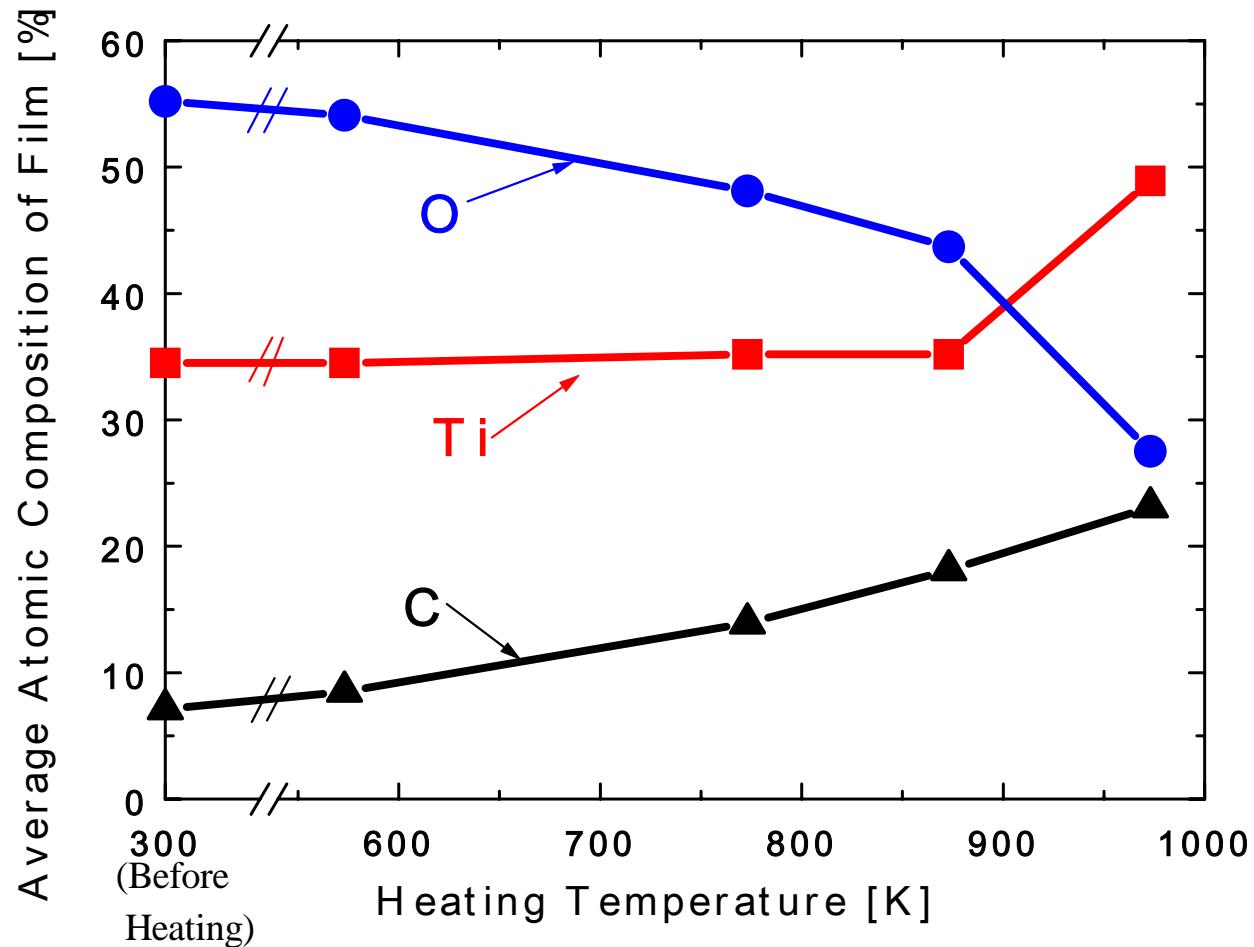
573 K , 5 hr



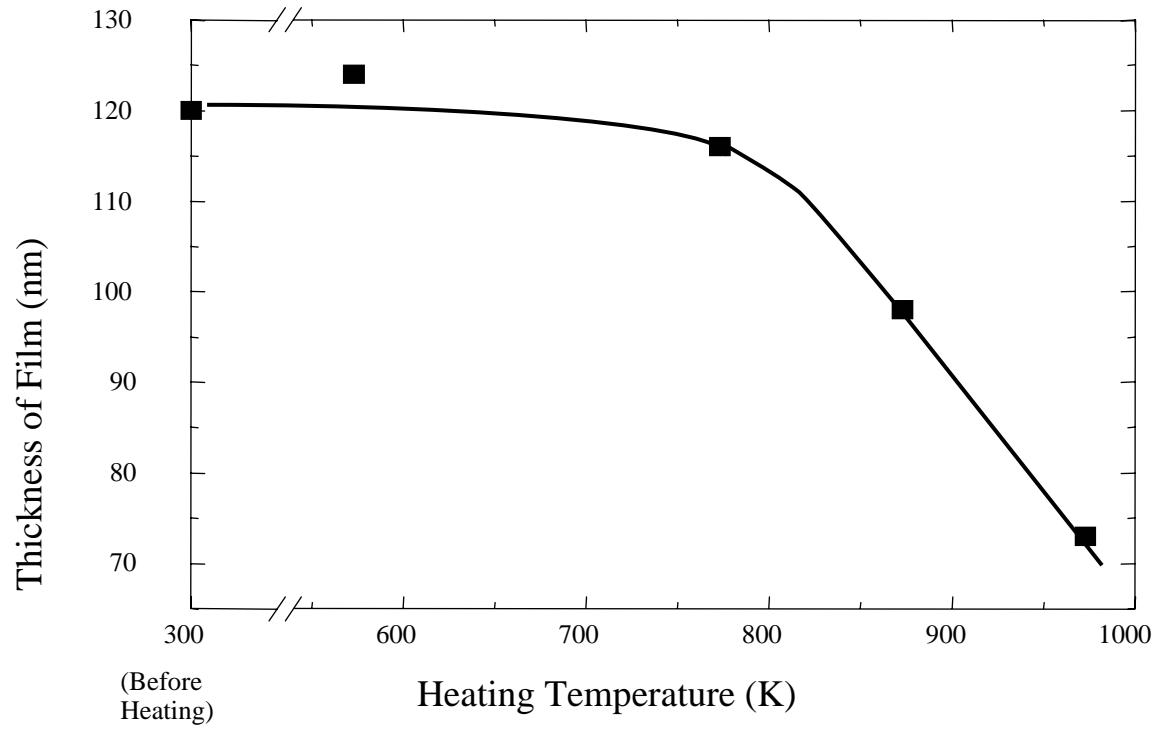
975 K , 5 hr



Atomic composition

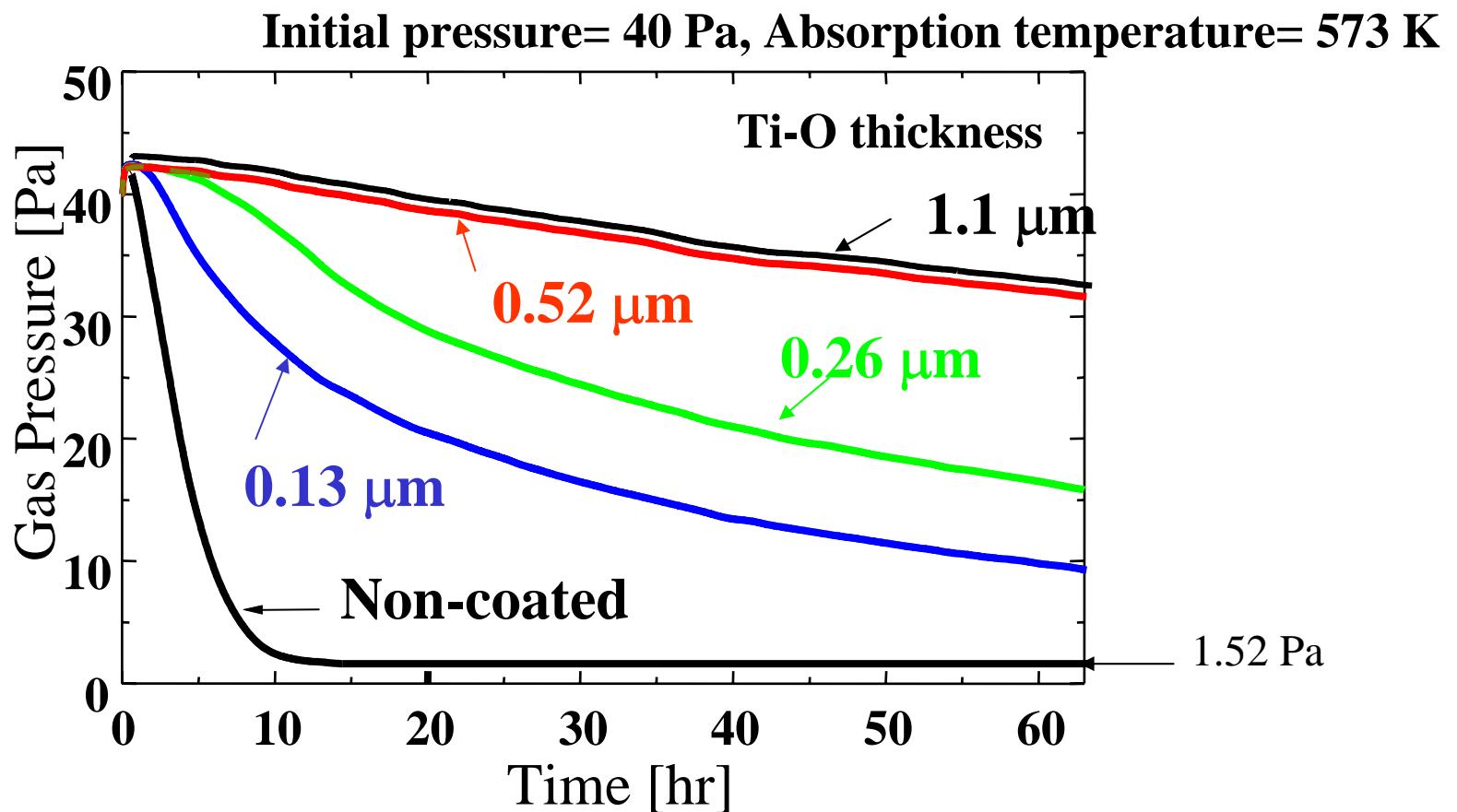


Film Thickness



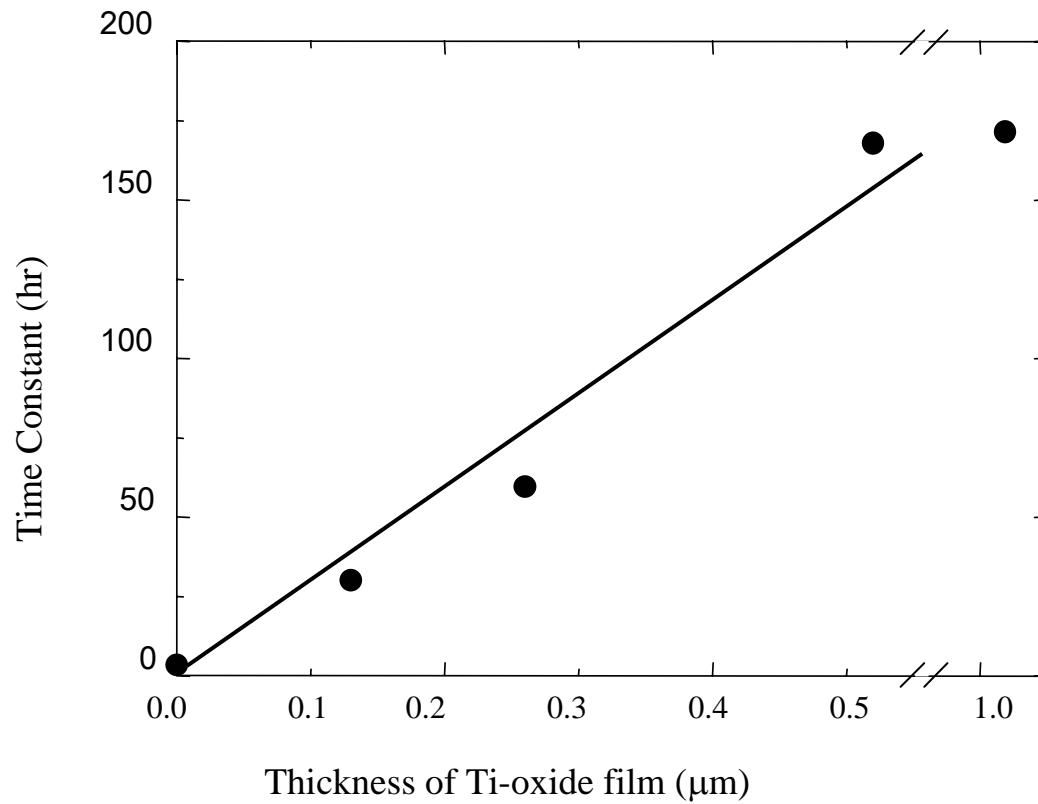
Ti-O film is thermally stable at low temperature.

(4) Reduction of hydrogen absorption speed



By Ti-O coating, absorption speed was largely reduced.

Time constant of hydrogen absorption, $C_H = C_0(1 - e^{-t/\tau})$



- τ with $(0.5\sim 1)\mu\text{m}$ coating is 50 times larger than τ without coating.
- Life time of V-alloy can be largely lengthened.