

Contamination & Optical lifetime Update

IEUVI Optics Contamination and Lifetime TWG

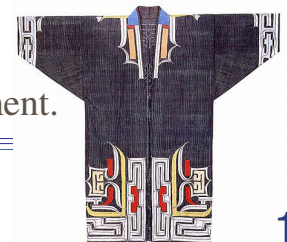
November 1, 2007

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Recent Activity

1. Contamination and cleaning study
2. From the presentations

Ainu traditional garment.



Presentations related to Cleaning and Resist-Outgassing
Picked up from CC section and partially RE.

	Japan			Korea
	EUVA	Selete	University of Hyogo	Hanyang University
Projection Optics	CC-P10 H.Takase	CC-02 I.Nishiyama	CC-P09 K.Koida	
Source Mirrors	CC-P02 T.Shirai			
Masks		CC-02 I.Nishiyama		CC-P14 T.Kim
Resist Outgassing		Re-P08 J.J.Santillan		Re-P09 S.Lee

Ainu traditional garment



Optics contamination:

- I.Nishiyama(Selete), “Atomic hydrogen cleaning for EUV optics contamination”,
Carbon contamination is thoroughly removed and showed no damage to reflectivity; and this method is applicable to Ta₂O₅ absorber material for mask.
- T.Shirai(EUVA), “Debris mitigation and mirror cleaning for Sn-fueled EUV source”,
More than 60 times halogen cleaning keeps high reflectivity.
- K.Koida(University of Hyogo), “Reduction of surface oxide layer of projection optics mirrors by EUV irradiation in presence of ethanol”,
- H.Takase(EUVA), “Characteristics of additional carbon on the surface of carbon capping layer”.
Carbon deposition rate is proportional to square root of EUV intensity.



Mask cleaning:

- T.Kim(Hanyang University), “Surface properties of EUVL mask layer after high energy laser shock cleaning”, alumina particles are safely removed by laser shockwave.
- K.Sakai(Toppan Printing), “A study of cleaning characteristics for EUV mask blank”, Organic compound contamination can be removed by UV/O₃ cleaning and showed no damage.

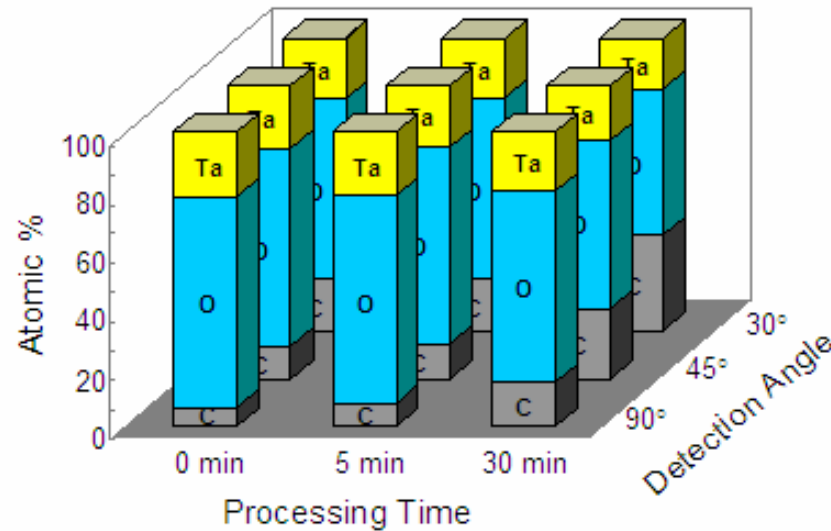
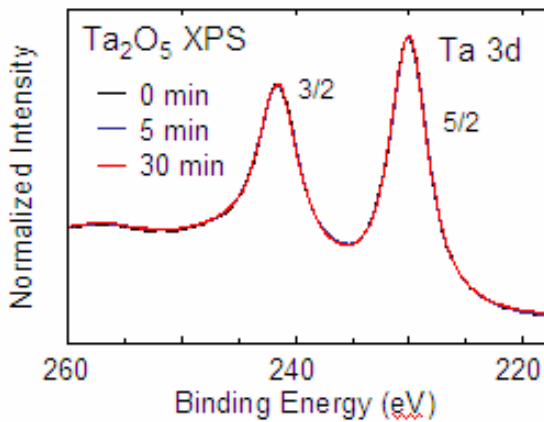
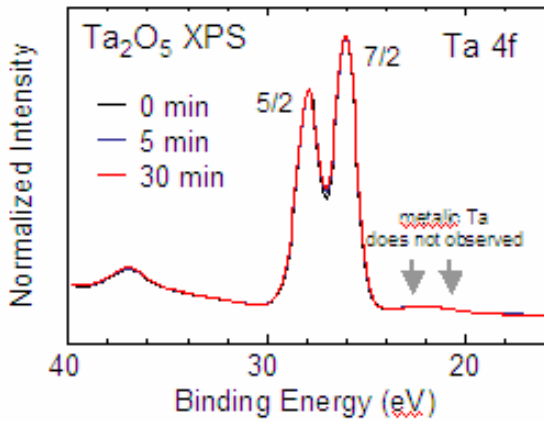
Resist outgassing:

Not cited here.



IRAI Impact of atomic hydrogen on Ta₂O₅

Selete



Ta₂O₅ is stable to atomic hydrogen treatment

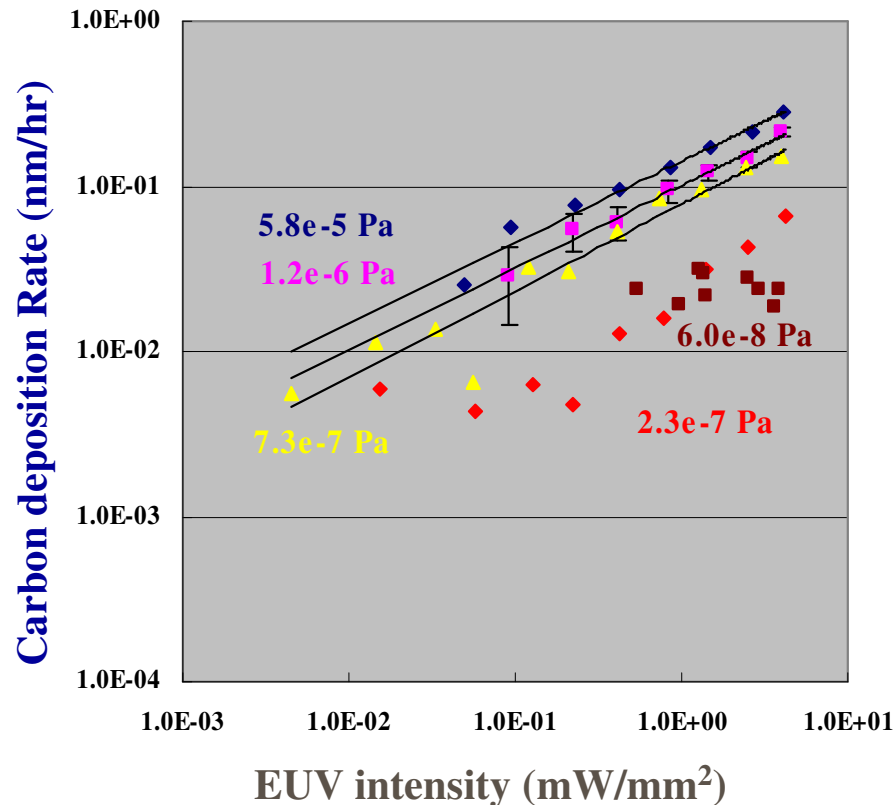
Oct. 31, 2007

EUVL Symposium 2007, Sapporo

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CC-P10: Characteristics of additional carbon on the surface of the carbon capping layer (Takase, *et al.* EUVA)

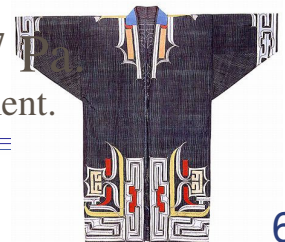


Sample:
[Si(4.2nm)/ Mo(2.8nm)]⁵⁰

Contamination source:
decane C₁₀H₂₂

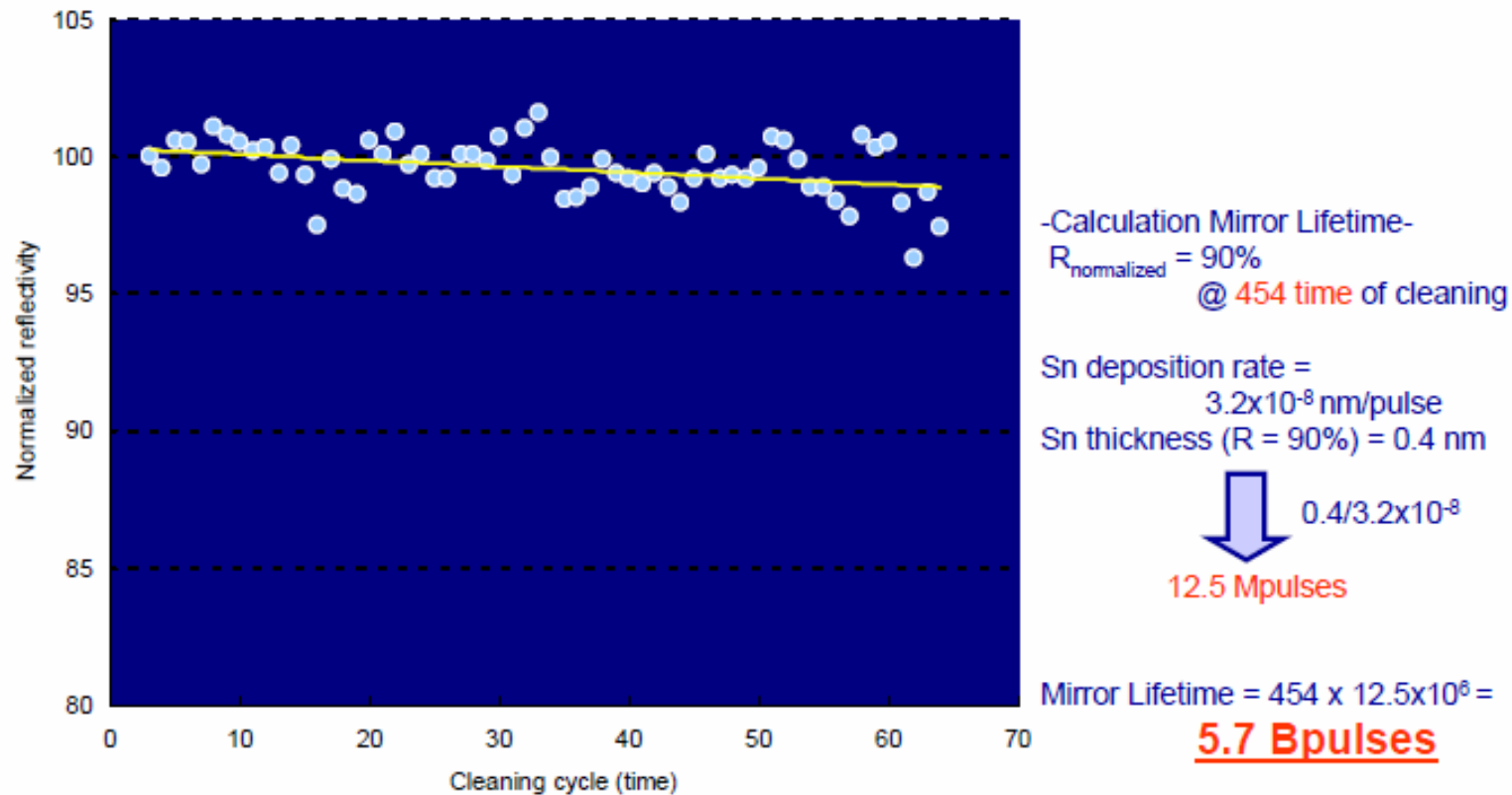
The carbon deposition rate is **proportional to the square root of EUV intensity** at 4 mW/mm² or less with decane pressure more than 7.3 x 10⁻⁷

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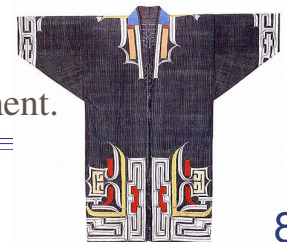
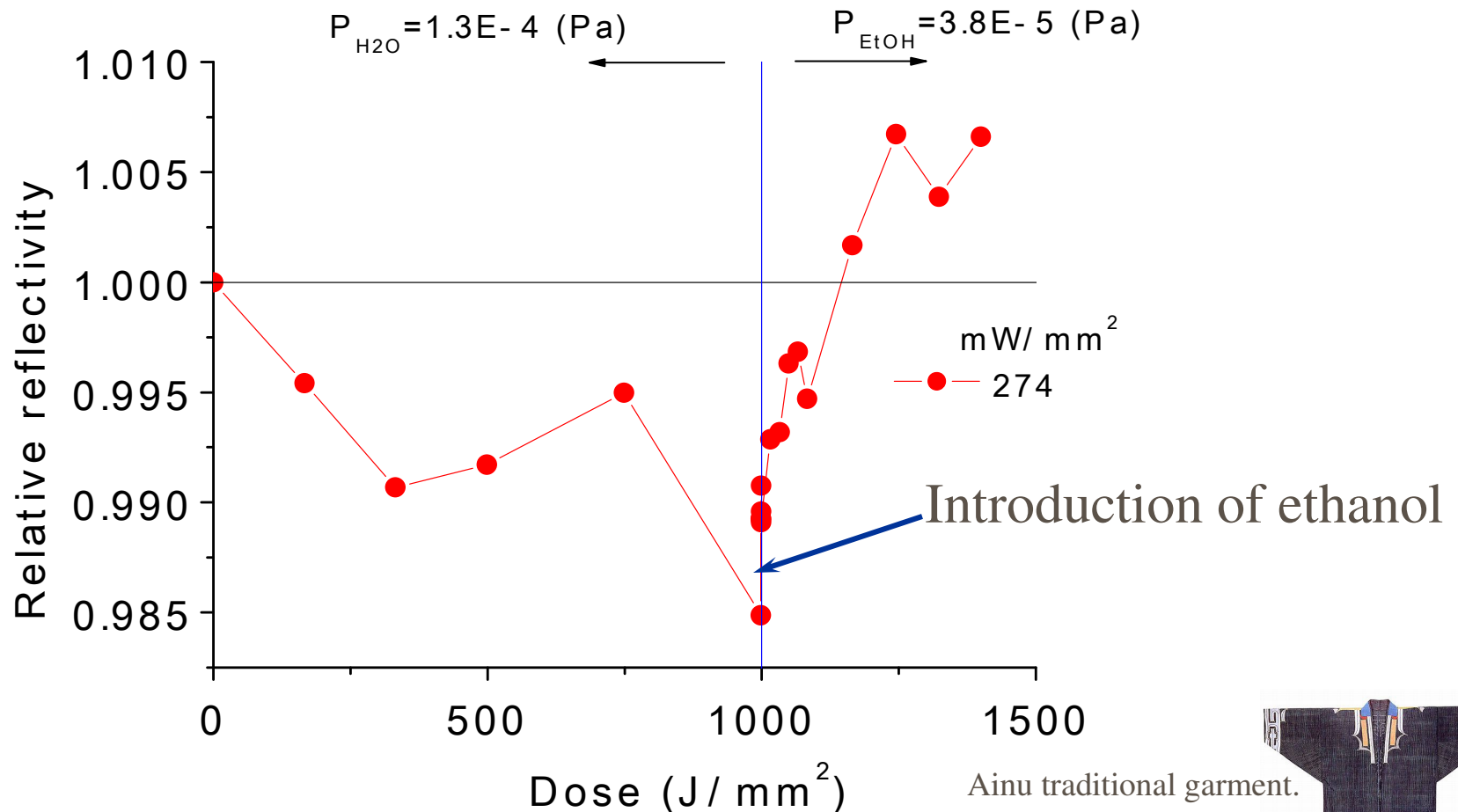
Mirror lifetime test of halogen cleaning

CC-P02: Debris mitigation and mirror cleaning for Sn-fueled EUV source (T. Shirai, *et al.*, EUVA)



Reduction of Ru capping layer in ethanol environment

CC-P09: Reduction of surface oxide layer of projection optics mirrors by EUV irradiation in presence of ethanol (K.Koida, *et al.*, Univ. of Hyogo)



For details, please see the presentations below:

CC-02: Atomic hydrogen cleaning for EUV optics contamination,

CC-P02: Debris mitigation and mirror cleaning for Sn-fueled EUV source,

CC-P09: Reduction of surface oxide layer of projection optics mirrors by EUV irradiation in presence of ethanol,

CC-P10: Characteristics of additional carbon on the surface of carbon capping layer,

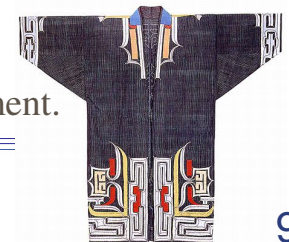
CC-P14: Surface properties of EUVL mask layer after high energy laser shock cleaning,

CC-P15: A study of cleaning characteristics for EUV mask blank,

RE-P08: EUV resist outgassing studies in Selete,

RE-P09: Outgassing study of resist for extreme ultraviolet lithography at PAL.

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Thank you

