Development of Novel Resist Polymers for EUV Lithography

- Improvement of sensitivity by introducing fluorine atoms -

16 October, 2006
2006 International EUVL Symposium

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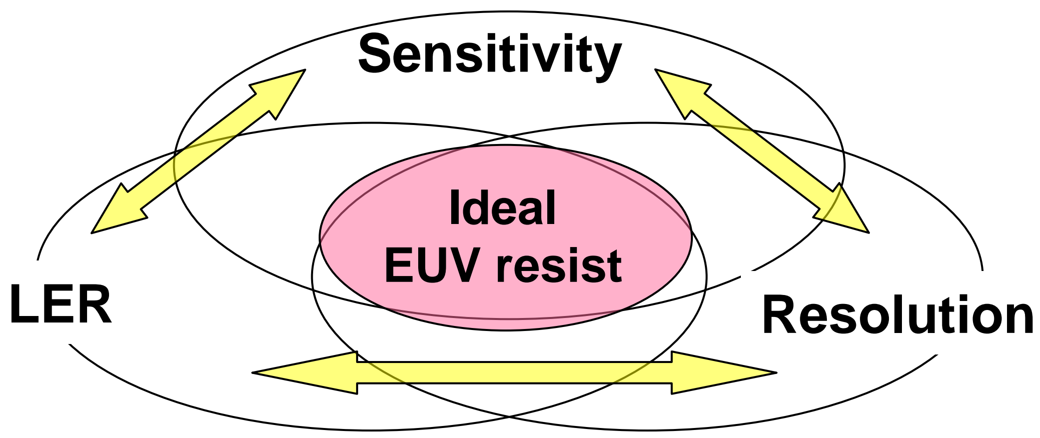
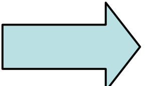
EUVL Resist - Our concept

Demands for EUV resist



	ITRS 2005
Sensitivity	5-15 mJ/cm2
Resolution	32 nm 1:1 L/S
LWR	1.7 nm



We focus on the resist sensitivity improvement in this study.

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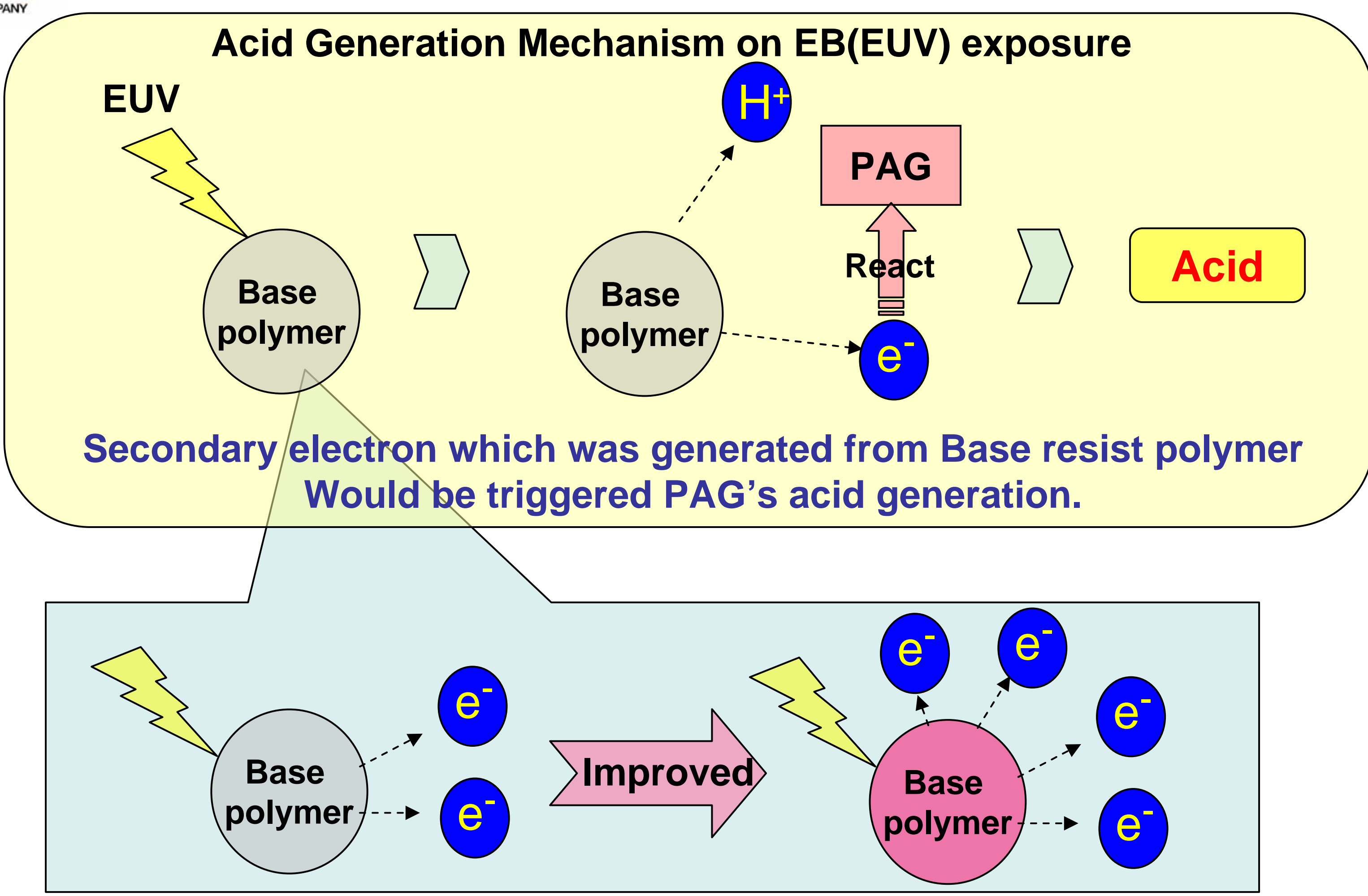
ASAHI GLASS COMPANY

	Polymeric	Molecular glass (R: tBOC)
Sensitivity	Easy to control	Depends on Structure
Thermal property	Good heat stability	Thermal decay Heat softening
LER	Mw.&size distributions	Small size No distributions

We focus on the Polymeric resist in this study

EUVL Resist - Our concept



Can high efficiency of Secondary electron formation contribute to the resist sensitivity?

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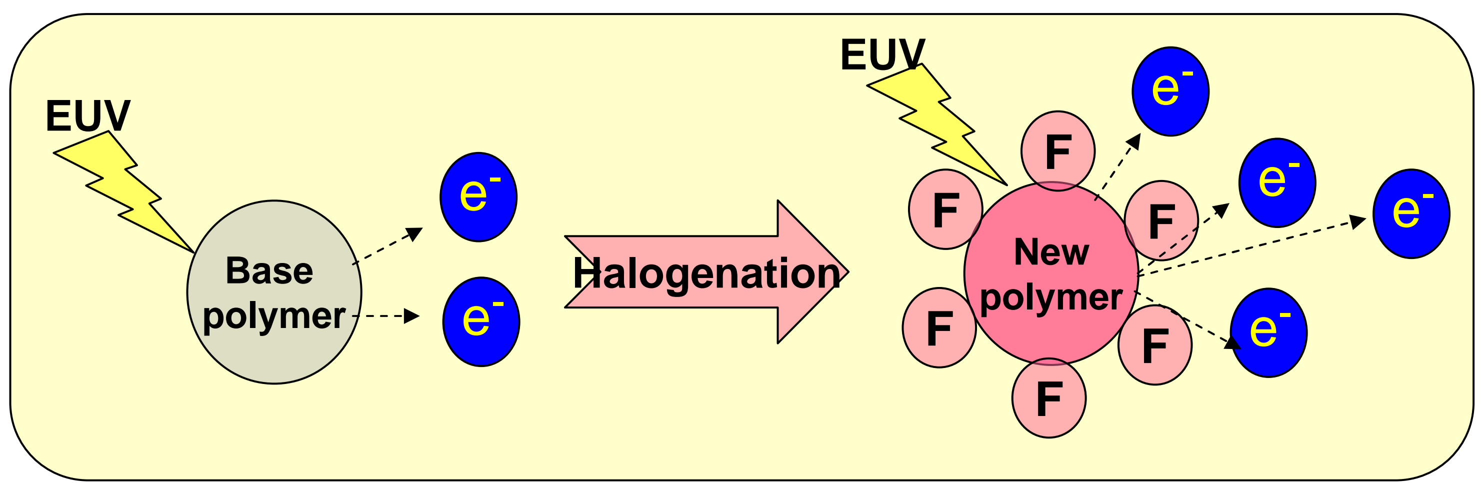
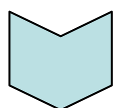


Halogenation ,especially Fluorination, is a good potentials to increase an absorption cross section against X-ray.



Can Halogenation enhance the secondary electron yield from polymers?

Evaluation Conditions

- Sample Polymers

l/m/n =30/40/30 mol%
Mw=11000

l/m/n =30/40/30 mol%
Mw=12000

- Sensitivity on EUV exposure

  - Samples: Polymers with 10wt% TPS –Nf on Si
  - Exposure: EUVES-7000 (Litho tech Japan)
  - PB: 100°C 90sec, PEB: 100°C 90sec
  - Development: NMD-3 60sec

- Etching test

  - Samples: Polymers on Si (200 nm)
  - Etcher: RIE-10NR (SAMCO Inc.)
  - CF_4/O_2 = 80/20 vol% 2Pa 70mW 60sec

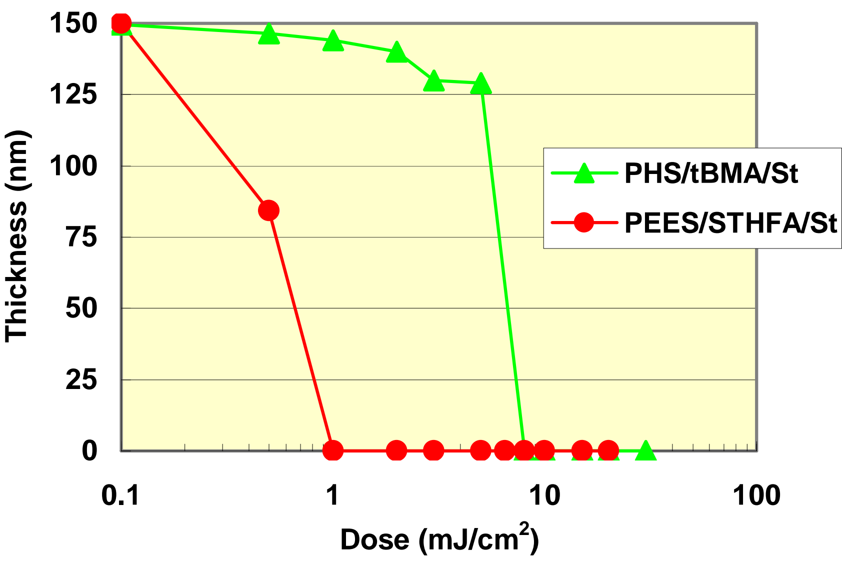
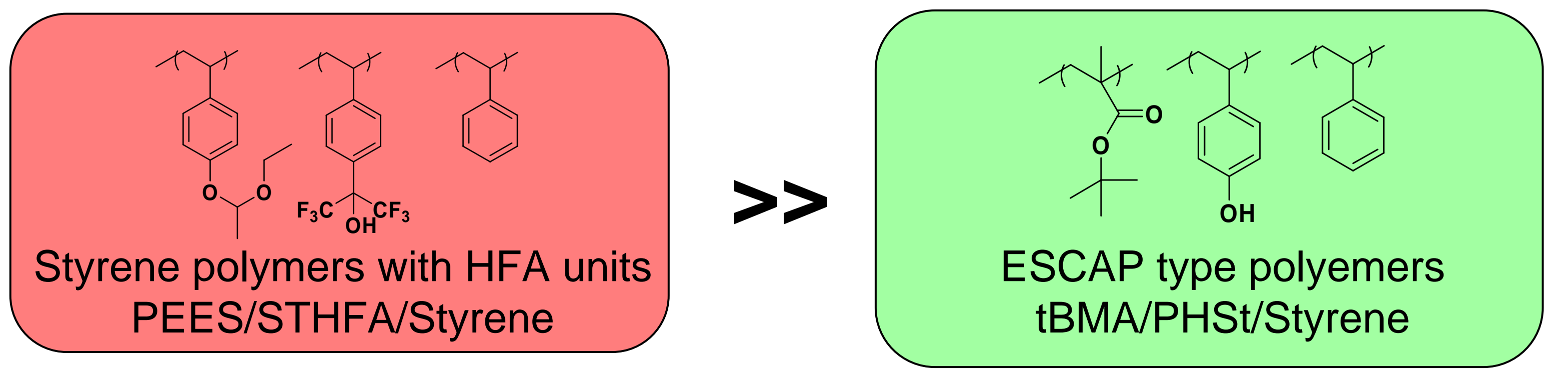


Fig. Sensitivity curves on EUV exposure



•Styrene polymers with HFA units showed high sensitivity relative to ESCAP type polymers

Etching durability

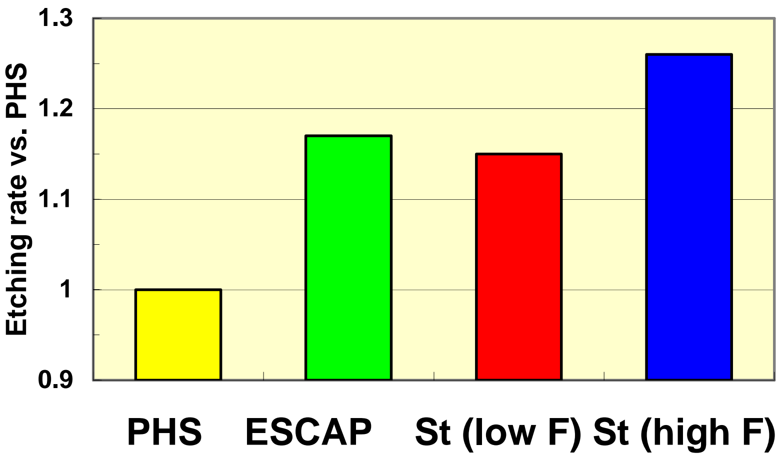


Fig. Etching rate relative to PHS

	PHS	ESCAP type Polymer	Styrene polymer low F contents	Styrene polymer high F contents
Ohnisi parameter	2.4	2.7	2.8	2.8
F contents wt%	0	0	23	40

- **Styrene polymers with proper F contents showed almost same etching durability relative to ESCAP type polymers.**

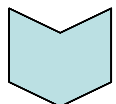
Summary & Future Plan

Summary

- We have been investigating fluorinated resist polymers for EUV lithography.
- Styrene polymers with HFA Unit show a high sensitivity relative to ESCAP type polymers.
- This result indicate that the resist sensitivity can be enhanced by introducing Fluorinated unit.
- Styrene polymers with proper F contents showed almost same etching durability relative to ESCAP type polymers.

Future Plan

- Other fluorinated polymers will be evaluated about sensitivity.



Confirmation of our concept