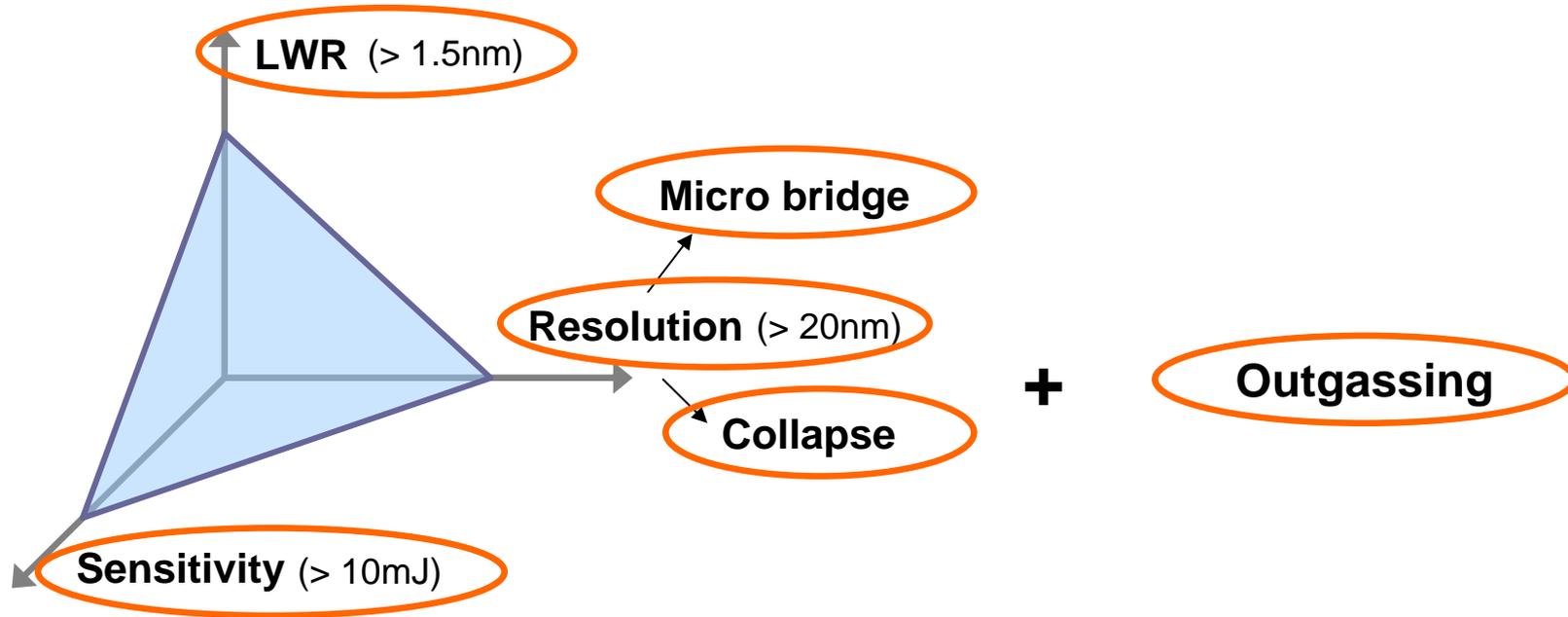


***The Novel Top-Coat Material
for RLS Trade-off reduction in EUVL
(OBPL: Out of Band Protection Layer)***

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Requirement characteristic of EUV resist



There are many items to be improved in EUVL.

Improvement point of EUV PR

- Improvement of resolution and LWR
- Prevent of Micro bridge
- Prevent of Outgass from PR
- Enhance photo speed

One of the option

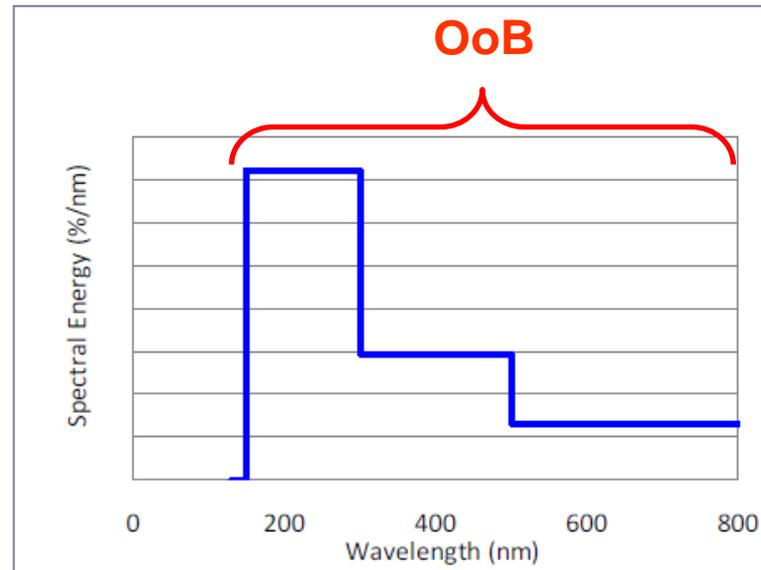
Top-Coat Material (OBPL: Out of Band Protection Layer)

Next Page

TC has capability to enhance the photo resist performance.



EUV source mix OoB spectrum

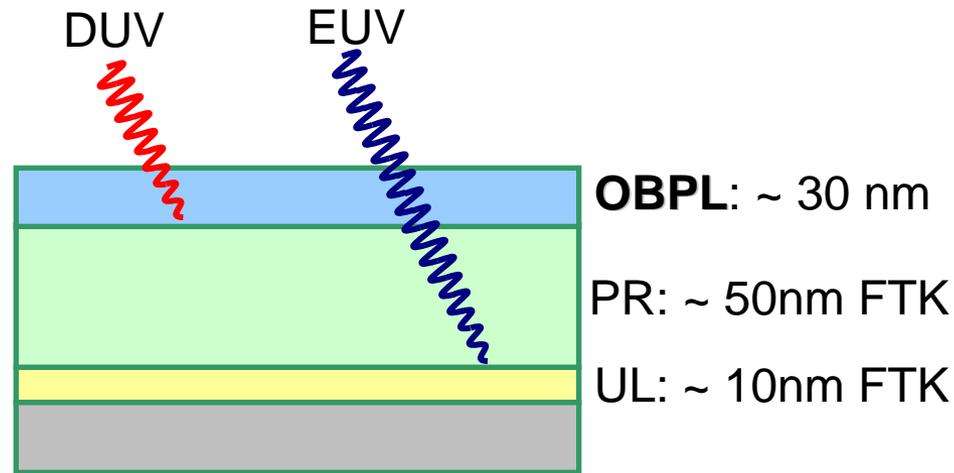


The peak top of OoB light is around 240nm.

The target of optical performance for OBPL is having absorbance at DUV (around 240nm) range.

Concept of OBPL

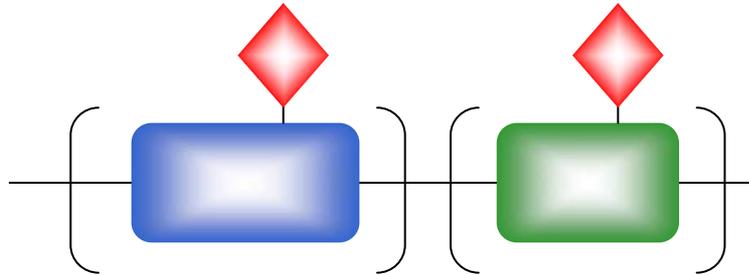
- Target
1. Improvement of PR profile
 2. Prevention of outgassing from PR



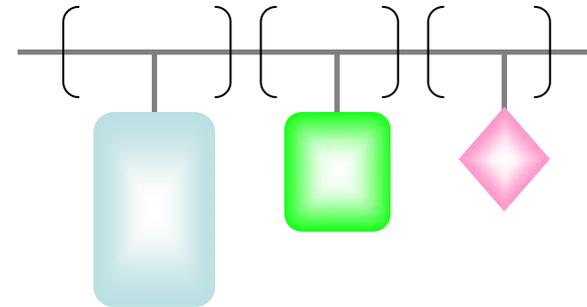
Characteristic of OBPL :

1. High absorption for DUV (Absorption peak is around 240nm)
2. High Transmittance for EUV (13.5nm)
3. Chemically control the resist performance
4. Prevention of outgassing from PR
5. No mixing with PR film
6. removable dissolving unit is introduced Chromophore unit or co-polymeried

OBPL-A



OBPL-B



KrF absorption unit
(Chromophore)



ArF absorption unit
(Chromophore)



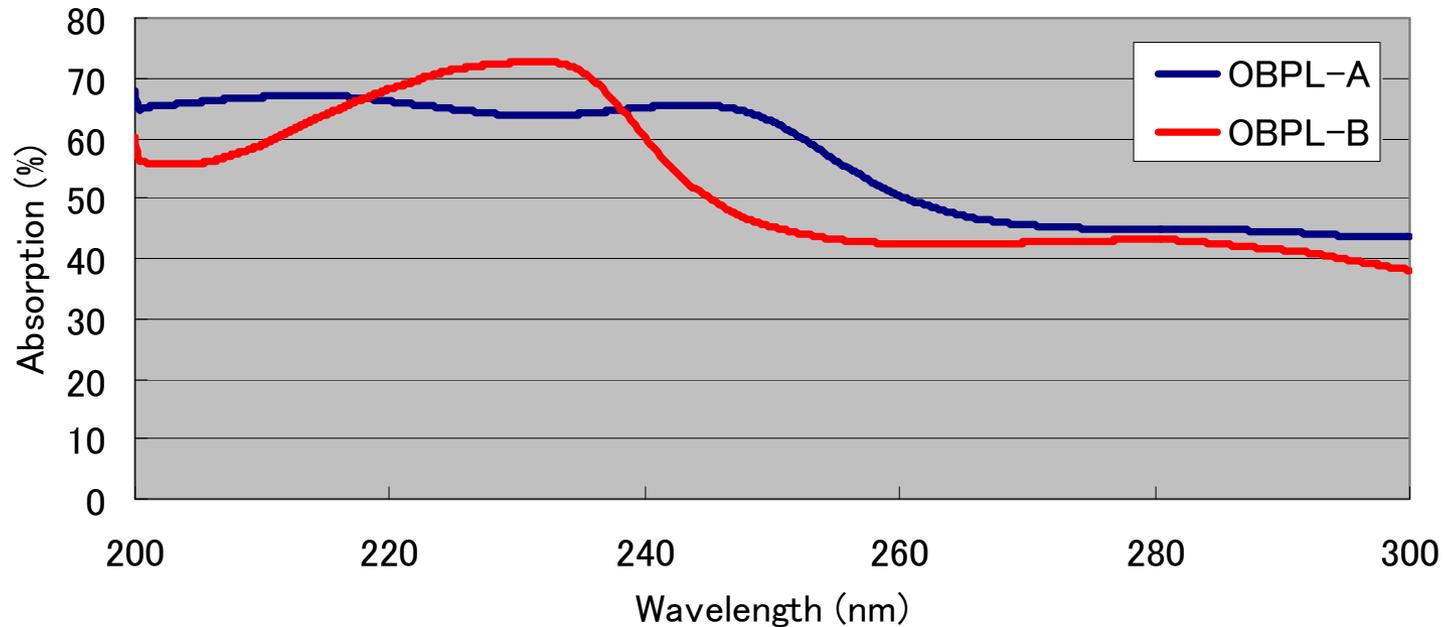
Solvent and alkaline dissolving unit

**OBPL is designed by high OoB chromophore content
and solubility unit**

Optical Parameter for DUV light

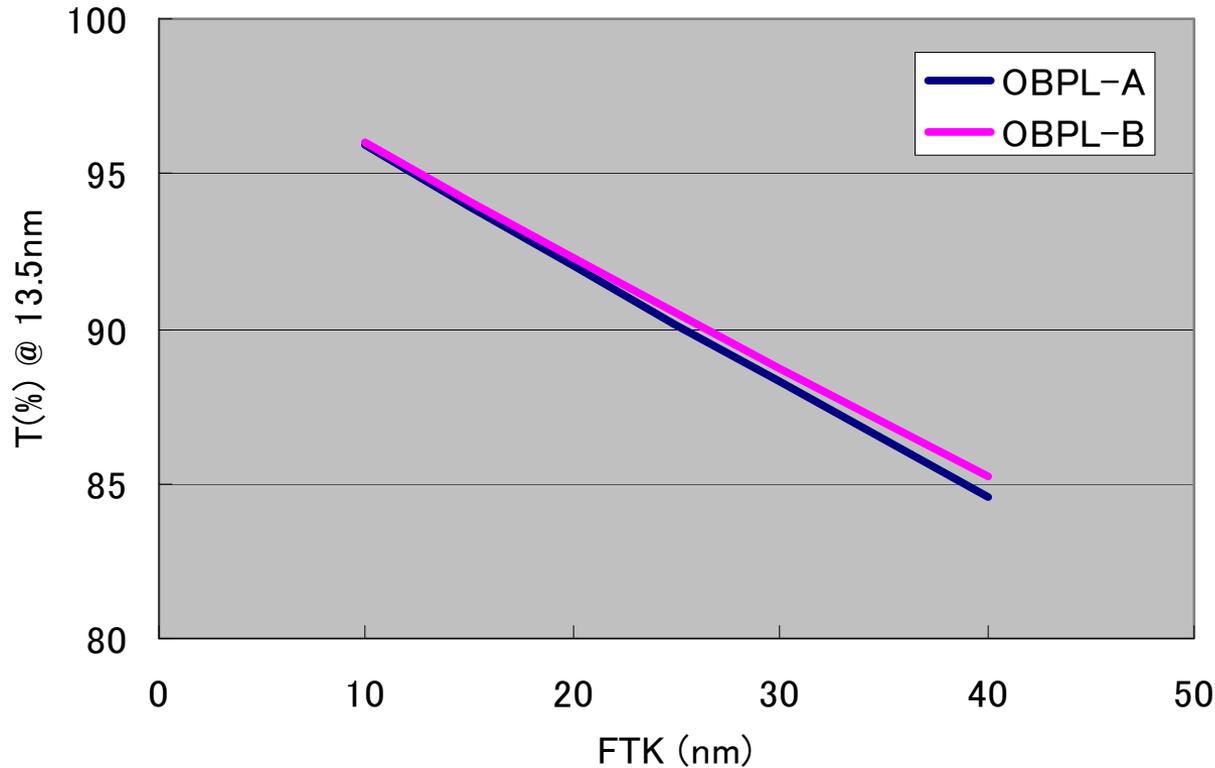
Absorption(%) vs Wavelength (nm)

OBPL thickness:
30nm



Absorption peak is 220~250nm (nearly KrF)

Transmittance@13.5nm (%) vs OBPL FTK



**When OBPL thickness is 30nm,
transmittance for EUV light is about 90%.**

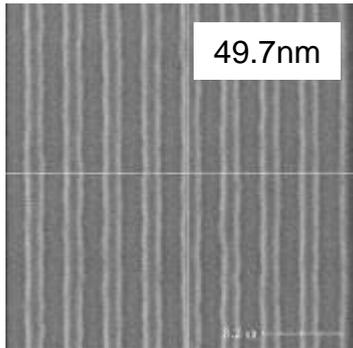
	OBPL FTK	Transmittance 13.5nm (Simulation)	Absorption 220~240nm (Measured)
OBPL-A	30nm	88%	63~64%
OBPL-B	30nm	89%	60~72%

**OBPL showed high transmittance for EUV light
and high absorption for DUV light.**

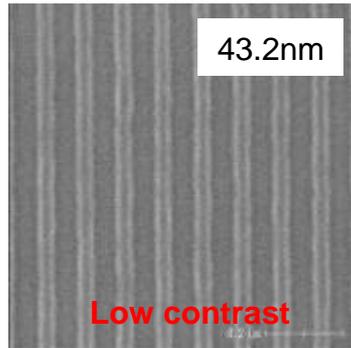
Study of PR profile control

Exposure tool: EB, Pattern: 50nm hp

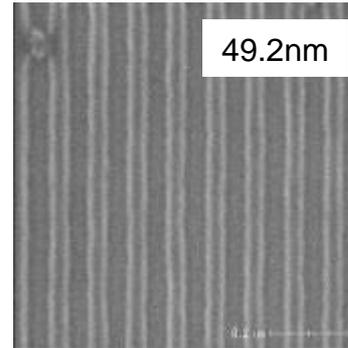
w/o OBPL



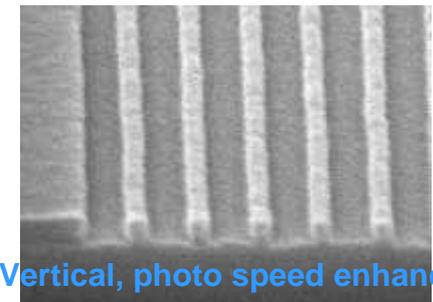
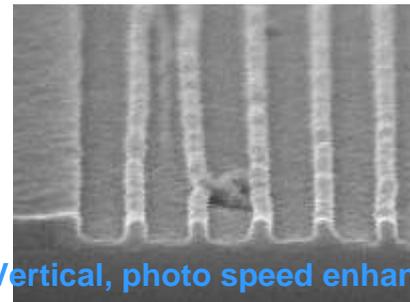
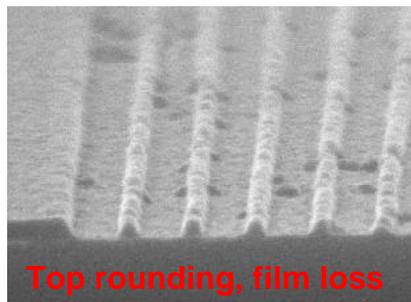
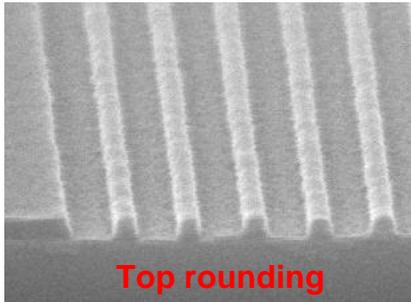
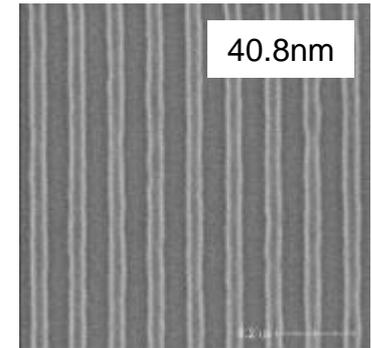
OBPL-B



OBPL-B
+ additive A



OBPL-B
+ additive B



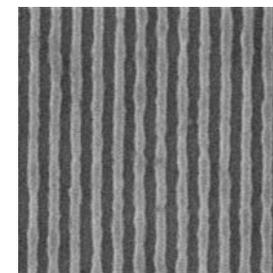
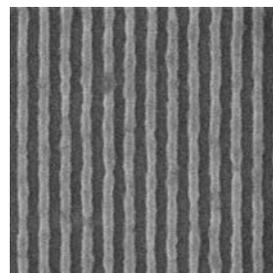
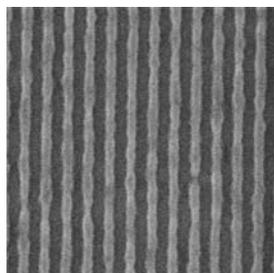
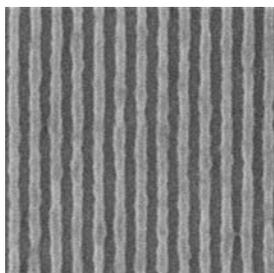
When OBPL-B sample was coated on PR, resist contrast became worse. However, OBPL including additive (chemically control) showed enhancement of profile control and photo speed.

EUV exposure test

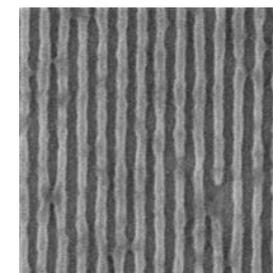
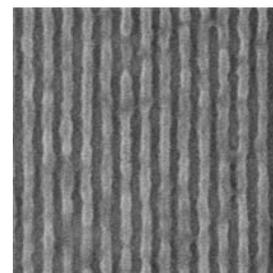
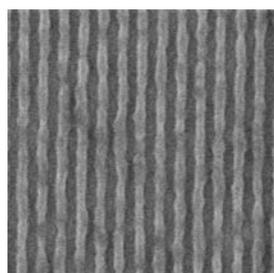
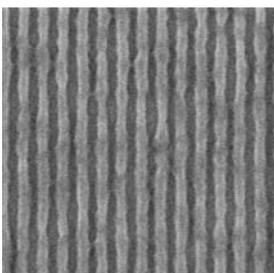


OBPL	w/o	OBPL-B	OBPL-B	OBPL-B
OBPL additive		none	Additive-A x%	Additive-A y%
EL	4.19	10.88	8.94	5.13
DOF	150	150	194	192
LWR	5.4	5.4	5.7	4.6
Sensitivity	9.36	10.85	11.2	11.82

26nm hp



24nm hp



OBPL showed enhancement of process margin and LWR.

Result of outgassing test

Evaluation site	Sample	Outgassing amount 13~200amu (molecular / cm ²)	
		OBPL only	OBPL / PR
 (RGA) Target: <5.0E+14	OBPL-A	7.11E+12	No data ↑ ↓
	OBPL-B	1.93E+13	
	OBPL-B + additive A	1.36E+13	
			(PR only) 1.3E+15
NSRRC	OBPL-A	8.9E+12	2.6E+14
	OBPL-B	1.8E+14	9.6E+14

Don't change

Improve!

Outgassing amount didn't change even if quencher was added to OBPL
OBPL material can reduce outgassing from PR

1. The target of TC material is reducing OoB effect and enhancement for the PR performance (RLS).
2. We develop TC material for EUV lithography based on optical type.
3. OBPL material was designed to have high absorption for OoB light and high transmittance for EUV light.
4. The chemically impact of OBPL to PR was investigated with EB. Introducing additive into OBPL was effective for profile control and photo speed enhancement.
5. Result of EUV exposure, OBPL material showed improvement of process margin and LWR.
6. Outgassing amount of OBPL is within the target level. OBPL material can reduce outgassing from PR.