

# On the Out-gassing Standard for EUV Exposure Tool

Yasuaki Fukuda  
Canon Inc.

## Recent Results

Several methods to measure the out-gassing rates have been proposed and reported, but the results are different to each other.

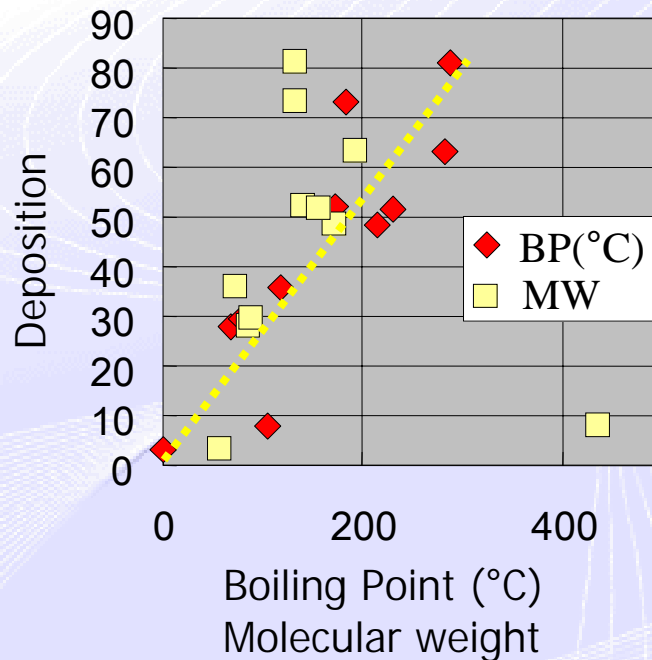
- 1) Methods and values (RGA, reflectivity, API,...)
- 2) Different conditions (W/WO EUV, Vacuum,...)
- 3) Target values (more than 2 order variation)

What is the significant index?

“Rate” is not a whole, ...

Carbon deposition strongly depends on the molecular weights or boiling points of the outgases.

Organic compounds and Deposition



Organic compound	Deposition	BP °C	Mol.Wt
Butane	3.3	-1	58
Hexane	27.7	69	86
methyl propionate	29.6	79	88
Perfluoro-octane	7.8	104	438
Butanol	35.7	117	74
Decane	52.2	174	142
diethylbenzene	73	183	134
methyl nonanoate	48.4	214	172
Decanol	51.8	231	158
dimethylphthalate	63.3	283.7	194
Hexadecane	81.1	287	134

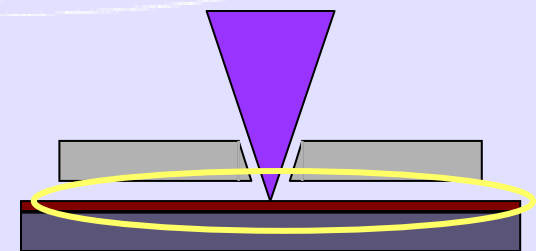
EUVA results, Matsunari *et al.*

## In what environment does it occur?

Out-gassing is accelerated by EUV irradiation.

Denbeaux's result is very suggestive:  
"Outgassing @dose to clear".

Deposition due to out-gassing may cause additional effects to optical characteristics.



## So how do we think ...?

“Rate” is sometimes a good index, but sometimes not.

We have to find out the worst chemical compounds from the *usable* resists.

We need more experimental data on out-gassing from the *usable* resists under exposure condition.

Deciding the specification of out-gassing, design or structure of the exposure tool should be considered.

We are making efforts to decide the specification value of out-gassing from resists.