Cascade and cluster of correlated reactions as causes of stochastic defects in extreme ultraviolet lithography (Erratum)

Hiroshi Fukuda
Hitachi High-Tech Corporation, Tokyo, Japan

[DOI: 10.1117/1.JMM.21.3.039802]

This article [H. Fukuda, *J. Micro/Nanolith. MEMS MOEMS* 19(2), 024601 (2020), doi: https://doi.org/10.1117/1.JMM.19.2.024601] was originally published online on 12 May 2020 with an incorrect parameter unit in Table 1.

The parameter unit in Table 1 was incorrectly labeled as "eV" rather than "keV."

Original Table 1:

Table 1 Typical values and/or definitions of model parameters.

Variables	Values and definitions
Numerical aperture	0.33~0.55
Simulation area	2000 nm × 20~32 nm (for L/S)
Resist thickness	20 nm
Resist photo absorption	0.004 nm^{-1} (for CAR), 0.02 nm^{-1} (for MOx)
SE energy	0.015 eV (with 10% standard deviation)
SE blur	1.5 nm (mean free path of SE determined as a result of Monte Carlo simulation and dependent on density of PAGs or ligands)
Voxel size	1 nm (for MOx), 2 nm (for CAR)
PAG density	0.3 ~ 0.7 nm^{-3} (for CAR)
Acid diffusion blur	2~5 nm (for CAR)
Turn over number (TON)	Number of acid catalytic reactions per acid: 3~10 (for CAR)
Quencher level	quencher density/PAG density: usually set at 0.2 in this paper
Acid quencher mutual diffusion length	4 nm (for CAR)
Ligand density	1~4 nm^{-3} (for MOx)
Reaction density	Density of acid-catalytic reactions in CAR or reactions at ligands in MOx
Threshold reaction density Dc_R	Reaction density required for flipping the solubility of polymers or molecules, $Dc_R = Nc_R/\text{voxel size}^3$
Reaction site density	Density of reaction sites in resist matrix at which solubility changing reactions take place, such as protected moieties in CAR or ligands in MOx. Usually set at $2\,Dc_R$.
Potential reaction density	Possible maximum reaction density under no restriction in PAG and reaction site densities, approximated by (photon irradiation density) × (photo absorption) × (# of SEs/# of photon absorptions) × (# of acid generations/# of SEs) × TON
N_{max}	Maximum number of voxel through thickness, N_{max} = resist thickness/voxel size
$N_{SFV\,defect}$	Number of solubility flipped voxel through thickness required for spot pattern formation: set at $0.8\,N_{max}$ UOS in this paper.
$N_{SFV\,defect}$	Number of solubility flipped voxel through thickness required for spot defect generation: set at $0.5\,N_{max}$ UOS in this paper.

Corrected Table 1:

Table 1 Typical values and/or definitions of model parameters.

Variables	Values and definitions
Numerical aperture	0.33~0.55
Simulation area	2000 nm × 20~32 nm (for L/S)
Resist thickness	20 nm
Resist photo absorption	0.004 nm^{-1} (for CAR), 0.02 nm^{-1} (for MOx)
SE energy	0.015 keV (with 10% standard deviation)
SE blur	1.5 nm (mean free path of SE determined as a result of Monte Carlo simulation and dependent on density of PAGs or ligands)
Voxel size	1 nm (for MOx), 2 nm (for CAR)
PAG density	0.3 ~ 0.7 nm^{-3} (for CAR)
Acid diffusion blur	2~5 nm (for CAR)
Turn over number (TON)	Number of acid catalytic reactions per acid: 3~10 (for CAR)
Quencher level	quencher density/PAG density: usually set at 0.2 in this paper
Acid quencher mutual diffusion length	4 nm (for CAR)
Ligand density	1~4 nm^{-3} (for MOx)
Reaction density	Density of acid-catalytic reactions in CAR or reactions at ligands in MOx
Threshold reaction density Dc_R	Reaction density required for flipping the solubility of polymers or molecules, $Dc_R = Nc_R/\text{voxel size}^3$
Reaction site density	Density of reaction sites in resist matrix at which solubility changing reactions take place, such as protected moieties in CAR or ligands in MOx. Usually set at 2 Dc_R.
Potential reaction density	Possible maximum reaction density under no restriction in PAG and reaction site densities, approximated by (photon irradiation density) × (photo absorption) × (# of SEs/# of photon absorptions) × (# of acid generations/# of SEs) × TON
N_{max}	Maximum number of voxel through thickness, N_{max} = resist thickness/voxel size
$N_{SFV\,pattern}$	Number of solubility flipped voxel through thickness required for spot pattern formation: set at 0.8 N_{max} UOS in this paper.
$N_{SFV\,defect}$	Number of solubility flipped voxel through thickness required for spot defect generation: set at 0.5 N_{max} UOS in this paper.

The results were obtained using the parameters in the correct units, and this error did not impact the results reported in the article. The corrected paper was republished on 13 July 2022.