was resolved at the optimum exposure dose. The edge roughness of a 100-nm line-and-space pattern was measured by SEM.

For a particular resist composition, an optimum PEB temperature for EB writing, sensitivity, and resolution are reported in Table 15.

TABLE 15

		Optimum PEB temp., ° C.	Sensitivity, μC/cm^2	Pattern profile	Resolution, μm
Example	1	100	12	rectangular	0.075
	2	100	10	somewhat rounded	0.070
	3	100	11	rectangular	0.050
	4	100	11	rectangular	0.055
	5	100	11	rectangular	0.055
	6	100	12	rectangular	0.050
	7	90	10	rectangular	0.055
	8	100	12	rectangular	0.055
	9	100	11	rectangular	0.060
	10	100	10	rectangular	0.050
	11	100	10	rectangular	0.065
	12	100	14	rectangular	0.055
	13	100	10	rectangular	0.055
	14	90	10	somewhat rounded	0.050
	15	100	10	rectangular	0.055
	16	100	11	rectangular	0.055
	17	90	10	rectangular	0.055
	18	100	12	rectangular	0.055
	19	100	13	rectangular	0.060
	20	100	8	somewhat rounded	0.055
	21	90	9	somewhat rounded	0.055
	22	90	10	rectangular	0.055
	23	90	11	rectangular	0.050
	24	90	9	rectangular	0.050
Comparative	1	120	16	slightly tapered	0.090
Example	2	120	16	slightly tapered	0.090
	3	110	14	rectangular	0.090
	4	120	18	tapered	0.085
	5	120	18	tapered	0.085
	6	110	16	tapered	0.085

As seen from Table 15, the resist compositions within the scope of the invention exhibit a high sensitivity and high resolution as compared with the comparative resist compositions. The optimum PEB temperature for the inventive resist compositions is lower than that for the comparative resist compositions, indicating that the inventive resist compositions have a higher sensitivity. Examples 3 to 24 exhibit better resolution than Examples 1 and 2, indicating that copolymerization of indene or acenaphthylene units provides a higher contrast.

Evaluation of ArF Excimer Laser Lithography

Each of positive resist compositions (Examples 25 to 50 and Comparative Examples 7 to 12) was spin coated on a silicon wafer having an antireflective coating (ARC-29A, Nissan Chemical Industries, Ltd.) of 78 nm thick and baked at 110° C. for 60 seconds, forming a resist film of 120 nm thick. The coated wafer was exposed by means of an ArF excimer laser stepper (Nikon Corp., NA 0.85), post-exposure baked (PEB) for 60 seconds, and puddle developed with a 2.38 wt % tetramethylammonium hydroxide aqueous solution for 30 seconds, forming a 1:1 line-and-space pattern and a 1:10 isolated line pattern. During the PEB, an optimum temperature for each resist composition was employed.

The patterned wafer was observed under a top-down scanning electron microscope (TDSEM). The optimum exposure (Eop) was defined as the exposure dose (mJ/cm^2) which provided a 1:1 resolution at the top and bottom of a 80-nm 1:1 line-and-space pattern. The maximum resolution of the resist was defined as the minimum line width (on-mask size, in increments of 5 nm) of a 1:1 line-and-space pattern that was resolved and separated at the optimum exposure, with smaller values indicating better resolution. The 1:10 isolated line pattern at the optimum exposure was also observed for determining an actual on-wafer size of the isolated line pattern with an on-mask size of 140 nm, which was reported as mask fidelity (on-wafer size, a larger size being better). The pattern was visually observed to see whether or not its profile was rectangular.

Table 16 tabulates the test results (maximum resolution, mask fidelity and profile) of the inventive and comparative resist compositions.

TABLE 16

		Optimum PEB temp., ° C.	Eop, mJ/cm^2	Maximum resolution, nm	Mask fidelity, nm	Pattern profile
Example	25	90	37	70	88	rectangular
	26	90	34	70	90	rectangular
	27	90	36	70	91	rectangular
	28	90	37	70	91	rectangular
	29	90	34	70	92	rectangular