NIL masters and surface modification

Masters and silicon passivation coating

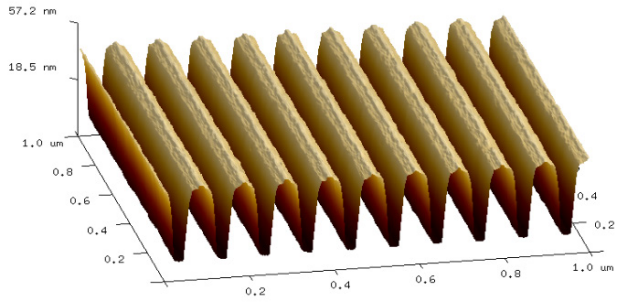

Figure 1 AFM image of a typical 300mm high precision master

Introduction

Nanoimprint Lithography (NIL) has demonstrated its value in manufac-turing nanostructures with extremely tight tolerances for the optics indus-try. A key component of NIL consists of obtaining precision masters to use in producing stamps for mass replication. Silicon wafers are an ideal base material for these masters due to their considerable use in standard semiconductor processes. However, access to high quality masters has been limited due to significant equipment costs, thus limiting rapid proto-typing using NIL. To address this need, Moxtek offers a collection of masters making capabilities at different cost and quality targets. Specifically, we offer high precision masters up to 300mm in diameter made with state of the art tools; NIL replica of high precision masters up to 200mm in diameter using a Substrate Conformal Imprinting Lithography (SCIL) process; and Laser Interference Lithography (LIL) based masters up to 200mm in diameter. These masters in conjunction with NIL processes can help to break the ultra-high price barrier to nanoscale feature printing on the latest lithography scanners; therefore achieving fast DOE cycles at reasonable costs. We offer custom design options for high precision and LIL-based masters. NIL replica offers an economical solution to ac-cess masters patterns that are already available in house.

AFM Data for 300mm High Precision Master (Measurements in nm)										
Site	**Height Mean**	**Height STDev**	**Width Top Mean**	**Width Top STDev**	**Width Middle Mean**	**Width Middle STDev**	**Width Bottom Mean**	**Width Bottom STDev**	**Pitch**	**Max Pitch Dev**
1	50.82	0.33	43.31	1.27	53.50	1.09	61.19	0.71	101.56	6.86
2	48.43	3.36	43.27	1.49	53.58	1.36	61.24	1.44	101.56	2.93
3	50.93	0.38	44.12	1.69	54.17	0.82	61.45	0.79	101.56	2.93
4	50.37	0.43	42.62	1.92	53.23	0.79	60.70	0.60	101.56	2.93
5	48.41	0.23	43.32	1.45	52.86	1.06	59.97	1.12	101.56	2.93
6	51.01	0.30	43.77	1.62	53.58	1.03	61.12	0.95	101.56	2.93
7	50.78	0.32	43.79	1.40	53.23	0.90	60.67	0.86	101.56	2.93
8	51.04	0.29	45.38	1.02	54.92	0.79	62.24	0.83	101.56	2.93
9	50.72	0.35	44.54	1.22	53.58	0.92	60.78	0.81	101.56	3.91
10	48.91	0.28	46.16	1.38	55.27	0.97	62.49	0.94	101.56	2.93
11	48.35	0.31	46.43	1.42	55.23	1.15	62.10	1.08	101.56	2.93
12	49.13	0.25	46.61	1.26	55.70	0.98	62.76	0.91	100.59	2.93
13	49.18	0.20	46.63	1.33	55.67	0.88	62.73	0.82	101.56	2.93
Overall Average	49.85	0.54	44.61	1.42	54.19	0.98	61.49	0.91	101.49	3.31
Average STDev	1.116		1.445		1.018		0.889		0.269	

Table 1 AFM data of a typical 300mm high precision master

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In addition to high precision masters, Moxtek has been using its own proprietary LIL processes to produce patterns for Wire Grid Polarizers (WGPs) on 200mm wafers for over two decades. These processes can also produce patterns on the tens of nanometers scale and then be used to etch underlying layers. Using our lithography process we have been able to produce Silicon masters for NIL specifically with Line/Space, periodic pillar and hole structures (Figure 2) as well as pixelated polarizer arrays.

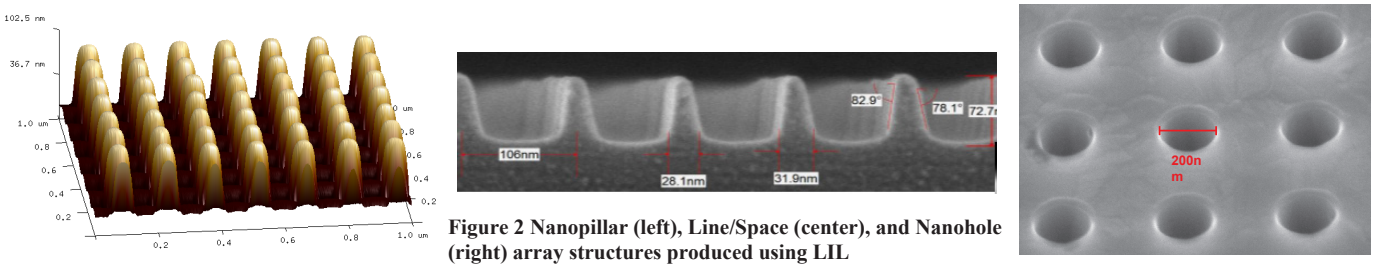

Figure 2 Nanopillar (left), Line/Space (center), and Nanohole (right) array structures produced using LIL

High Precision Master						
Size	**Type**	**Pitch**	**Line CD**	**Depth**	**Tolerance**	**Materials**
300mm	Line/Space	100nm	28-50nm	Up to 3:1 aspect ratio	+/-10% CD	Si
300mm	Line/Space	130nm	32-65nm	Up to 3:1 aspect ratio	+/-10% CD	Si
300mm	Nanohole	80nm	50nm Hole	Up to 3:1 aspect ratio	+/-10% CD	Si
300mm	Line/Space	112nm	32-56nm	Up to 3:1 aspect ratio	+/-10% CD	Si
300mm	Custom Design	Custom Design	Custom	Up to 3:1 aspect ratio	+/-10% CD	Si

NIL replica of High Precision Master						
Size	**Type**	**Pitch**	**Line CD**	**Depth**	**Tolerance**	**Materials**
200mm	Line/Space	100nm	28-50nm	Up to 3:1 aspect ratio	+/-10% CD	Si/Glass
200mm	Line/Space	130nm	32-65nm	Up to 3:1 aspect ratio	+/-10% CD	Si/Glass
200mm	Line/Space	80nm	30nm	Up to 3:1 aspect ratio	+/-10% CD	Si/Glass
200mm	Line/Space	112nm	32-56nm	Up to 3:1 aspect ratio	+/-10% CD	Si/Glass
200mm	Custom Design	Custom Design	Custom	Up to 3:1 aspect ratio	+/-10% CD	Si

LIL-Based Master						
Size	**Type**	**Pitch**	**Line CD**	**Depth**	**Tolerance**	**Materials**
200mm	Nanohole	180-700nm	70-300nm	20-250nm	+/-10% Pitch	Si/Glass
200mm	Line/Space	144 & 180-700nm	43-79 & 70-300nm	20-250nm	+/-10% Pitch	Si/Glass
200mm	Nanopillar	180-700nm	70-300nm	35-250nm	+/-10% Pitch	Si/Glass

Table 2 High precision, NIL, and LIL master characteristics

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