Silicon Photoresists for Patterning Processes

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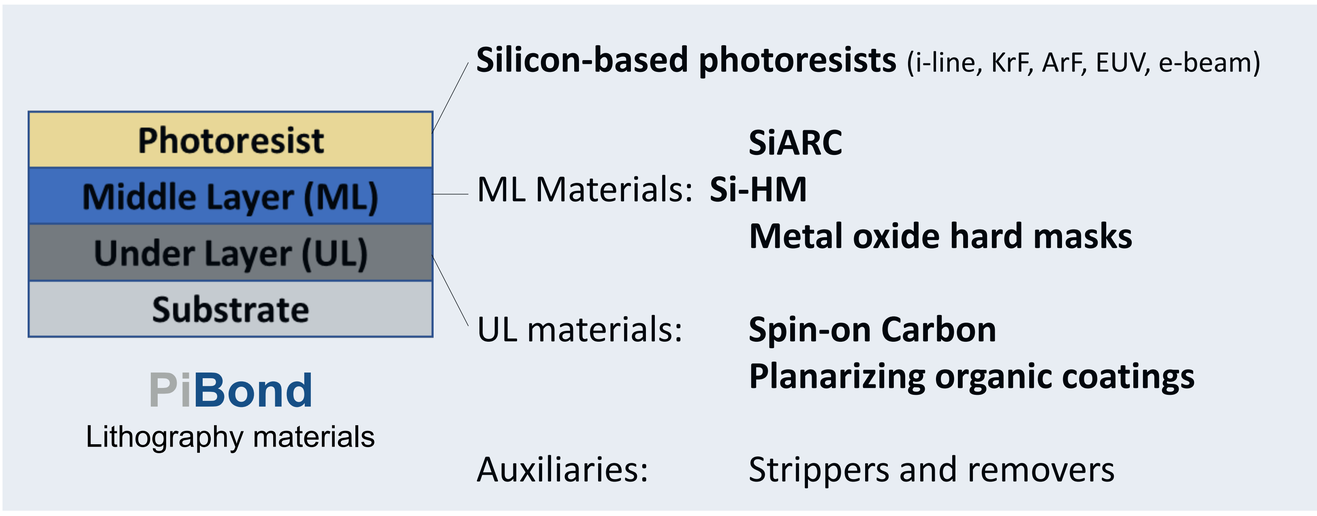
INTRODUCTION

PiBond is a leader in innovation of silicon-based advanced chemicals. We also develop novel metal oxide and complementary organic materials to our product portfolio.

Our liquid, spin-coatable polymer products encompass:

- Dielectric materials for FEOL and BEOL
- Lithography materials for i-line, KrF, ArF, EUVL and e-beam
- Optically clear silicone resins and adhesives



RESULTS

We have developed a suite of proprietary, patternable silicon-based photoresist (Si-PR) materials with variable properties. Properties, which can be adjusted include:

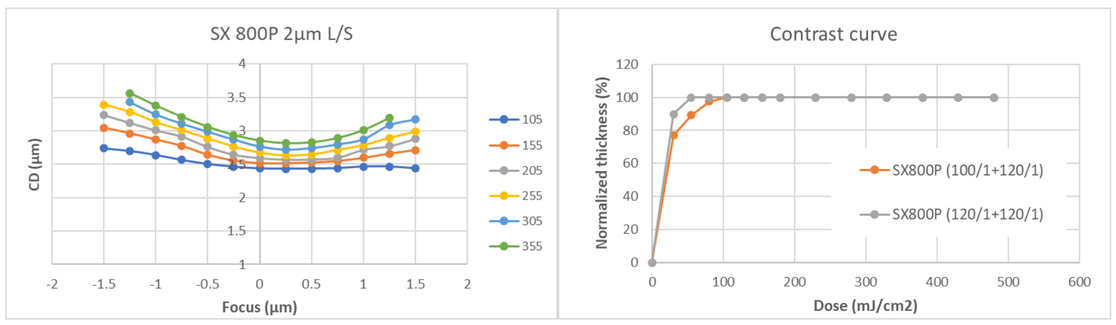
- Silicon content
- Cure temperature
- Patterning wavelength

Depending on properties or requirements, Si-PR may e.g., be used as a patternable middle layer or as a permanent, directly patternable SiO_2-like dielectric. Two products are introduced herein: SH 800P, PRE 400.

PiBond's Si-PR materials are compatible with existing infrastructure and exhibits compatibility to fab drain waste. The negative tone resists are developed using standard TMAH developers.

SX 800P – high resolution i-line patterning

SX 800P is a Si-PR for direct patterning with broadband or i-line exposure. A low dose of ~100mJ/cm^2 is required for full film retention. The product can be coated up to ~3µm thickness and cures to dense SiO_2-like material at 400-500°C. It also exhibits excellent transparency for optical and high silicon content for patternable hard-mask applications.



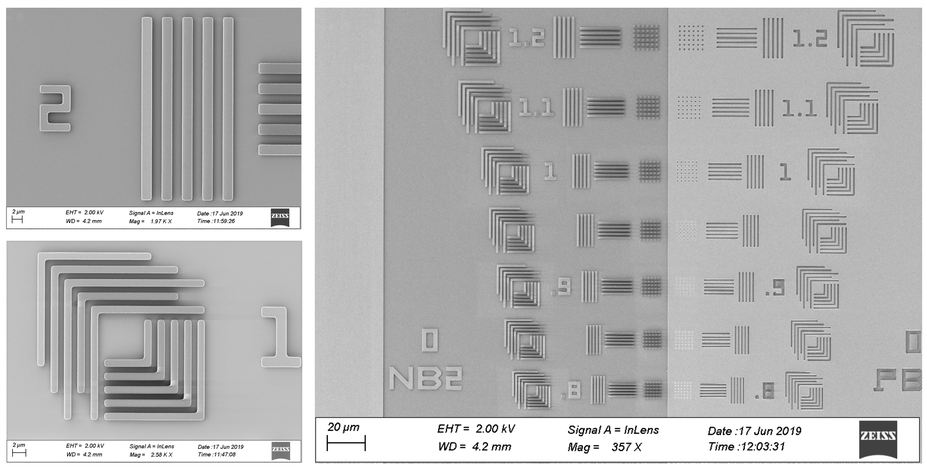


Figure 1. *Dose matrix, bossung plot SEM images of SX 800P. SB: 100°C/1min, Exp: 105mJ/cm^2, 0.65NA, PEB 120°C/1min, Develop 2.38w% TMAH 1min.*

PRE 400 – organic-inorganic hybrid, high-resolution resist

PRE 400 is a series of organically modified hydrogensilsesquioxane (HSQ) resins. The main features of the materials are:

- Decreased dose requirement compared to traditional HSQ resins
- High etch selectivity to organic underlayers
- Enables cost reduction through stack simplification: bilayer resist stack using a directly patternable Middle Layer
- Compatible with existing infrastructure: PGMEA-based formulation, no metal oxides, developed using aq. TMAH

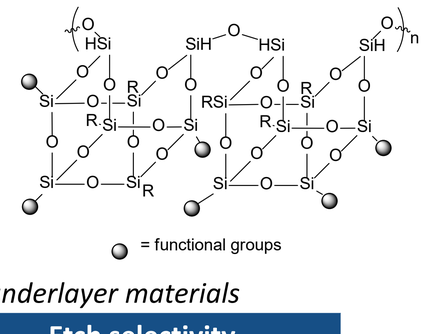


Figure 2. *Schematic representation of PRE 400 polymer.*

Table 1. *Dry etch rates and etch rate selectivities to underlayer materials*

	Soft bake [°C]	Etch rate [nm/min]	Etch selectivity to SOC*	Etch selectivity to OBARC
CF_4	80	62	1 : 0.4	- - -
	150	62	1 : 0.4	- - -
O_2	80	**7.3**	**1 : 45**	**>1 : 65**
	150	**4.7**	**1 : 70**	**>1 : 100**

*PiBond OTL 400 used as SOC

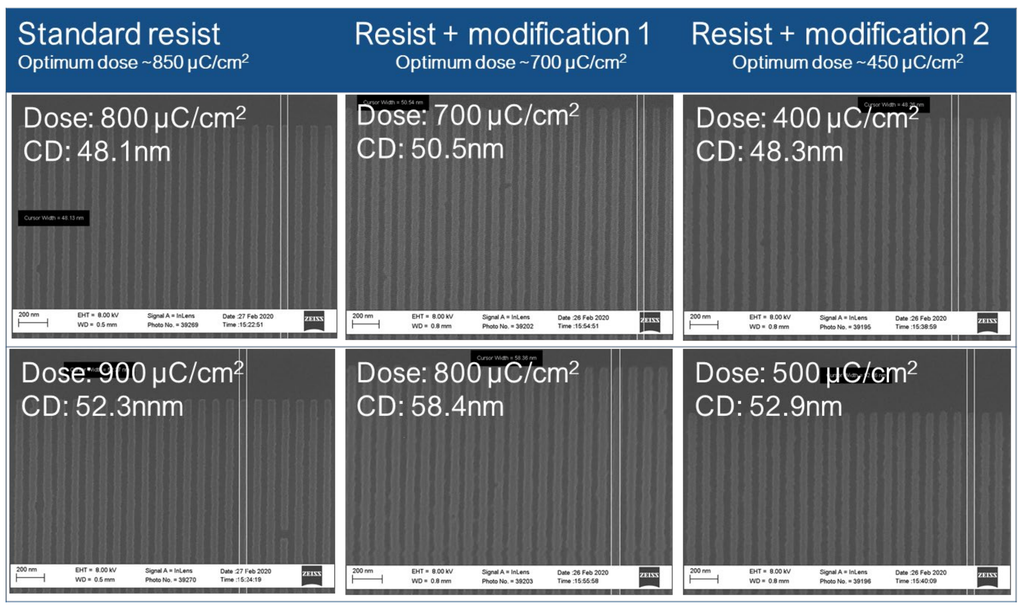


Figure 3. *PRE 400 chemical outline, resist etch data and e-beam pattern results of 50nm L/S.*

SUMMARY

PiBond has developed a series of novel, proprietary silicon-based photoresist materials, which can be patterned using effectively any lithography wavelength. The materials may be useful in myriad of applications requiring patterning, pattern transfer or a photo-definable dielectric coating. The materials can be applied using existing infrastructure and do not need special investments.

PiBond is a leading innovator of silicon and metal oxide based polymeric thin film materials used in the semiconductor, photonics applications and displays. Our vision is to ensure the success of our customers and their products through superior, innovative materials as well as consistent service and quality.

We are committed to world-class manufacturing operations with ISO 9001 and ISO 14001 certified quality and environmental management system. PiBond is a member of the Responsible Care initiative.

MANAGEMENT SYSTEM CERTIFICATION DNV·GL ISO 9001 ISO 14001

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