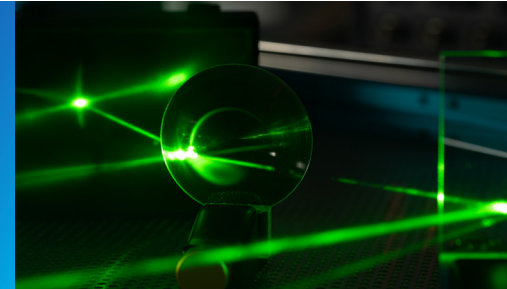


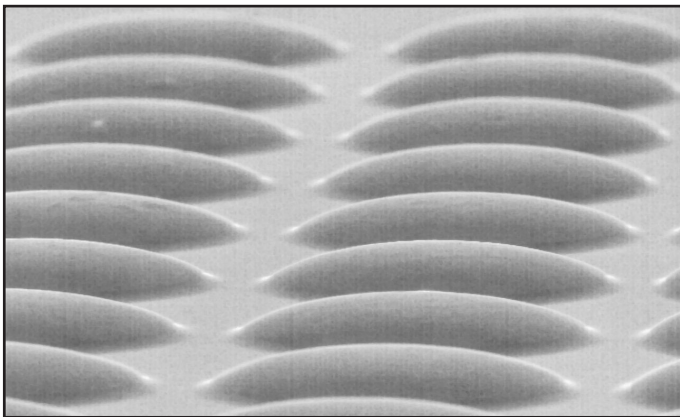
SPTS Etch and Deposition Processes for Photonic Device Manufacturing



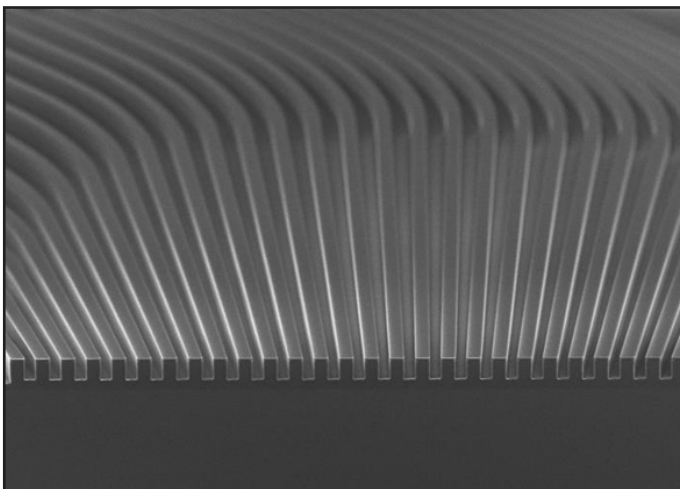
Emerging big data applications are now driving an ever-growing demand for faster data speeds, which can only be delivered by optical communication technologies. This has driven the demand for etch and deposition processes for optical components and systems.

SPTS (now a Division of KLA Corp.) has been manufacturing wafer processing equipment for photonic applications for over 20 years, with etch and deposition processes for planar waveguides, microlenses, photonic ICs, LEDs and LASERS.

Typical applications include deep dielectric etching, smooth etch sidewalls, PECVD of thick (doped and undoped) dielectric layers, and metal deposition for electrical contacts or via seed layers.



Fused silica microlenses

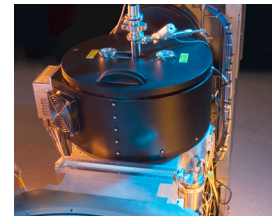


SiON waveguide

PROCESS MODULES

SPTS Omega® ICP

Module for etching a wide variety of materials for photonic applications, such as GaAs, InP, GaP, SiN_x and GaN.



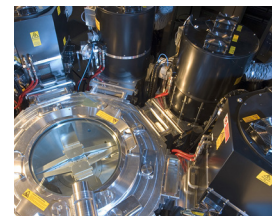
SPTS Omega® Synapse

Module with 10x ion density of ICP, designed to etch strongly bonded materials such as SiO_x, glass, LiNbO₃, SiC, GaN and sapphire.



SPTS Omega® DSI-v / Rapier

Established silicon DRIE modules for low loss, smooth sidewall etch profiles.



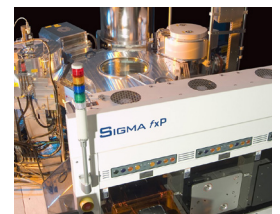
SPTS Delta™ PECVD

Deposition of a-Si, SiO_x, SiN and SiON layers with unparalleled RI, stress and thickness uniformity control at low deposition temperatures.



SPTS Sigma® PVD

High productivity metal layer deposition, for UBM/RDL



DEPOSITION

Silicon Oxide / Silicon Oxynitride Deposition

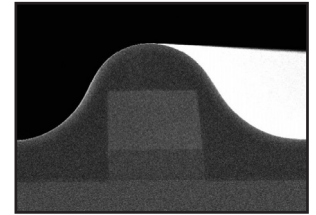
Thick layers of silicon oxide or silicon oxy-nitride (for example in waveguide manufacturing) require long deposition times and regular chamber cleans. To avoid chamber damage during cleaning, SPTS offers a novel remote plasma cleaning configuration, with end-point control to increase productivity. Film stress <math><10\text{ MPa}</math> is achieved in $\geq 6\mu\text{m}$ films, with refractive index tuneable independently of stress.

Amorphous Silicon Deposition

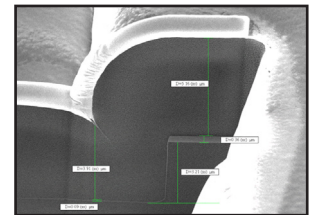
Typically used for infra-red waveguide applications where silicon oxide is too lossy, amorphous silicon can be deposited at temperatures $< 400^\circ\text{C}$ using PECVD with a silane plasma, which results in $\alpha\text{-Si:H}$ film. Minimizing hydrogen content of the films by careful precursor selection and process tuning is key to obtaining low optical loss.

Silicon Nitride Deposition

SiN films are widely used as anti-reflective coatings in active photonic devices such as VCSELs. Within wafer and wafer to wafer refractive index and thickness non-uniformities are maintained at $\pm 2\%$ using the Delta™ PECVD system. PECVD SiN is also increasingly used for bow compensation where substrates are kept essentially flat by equalizing the film stresses on both sides, thereby easing subsequent lithography steps.



SiO_x waveguide



Amorphous Si PECVD film

ETCH

Silicon Oxide Etching

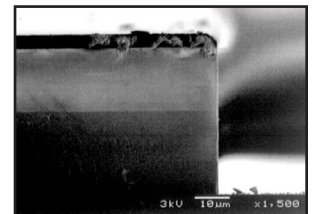
The Synapse etch system has a unique design which increases the ion density for high oxide etch rates, and the chamber is heated to reduce by-product deposition on the chamber walls to increase MTBC. Deep oxide etches to $>100\mu\text{m}$ can be achieved.

Compound Semiconductor Etch Processes

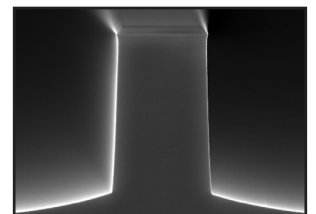
SPTS offers both its standard ICP and Synapse™ technology for etching compound semiconductors. These etch processes can be used to create smooth, vertical or tapered structures to form waveguides, microlenses, modulators, LEDs, and LASERS.

Silicon Etching

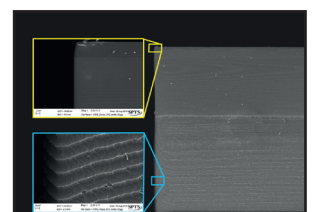
SPTS is a recognized leader in deep silicon etching. Our processes offer smooth sidewalls with high etch rates, controlled profile and unique end-point options. Our Rapier DRIE system processes wafers up to 12" in diameter, and can be used for etching Si-SiO_x stacks.



Deep oxide etch



InP waveguide



*Si DRIE with scallops
<math><20\text{nm}</math> deep*

KLA SUPPORT

Maintaining system productivity is an integral part of KLA's yield optimization solution. Efforts in this area include system maintenance, global supply chain management, cost reduction and obsolescence mitigation, system relocation, performance and productivity enhancements, and certified tool resale.

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