INDUSTRIAL DEVLOPMENT PROJECTS

Radiation hardness evaluation of position-sensing detectors exposed to extreme ultraviolet radiation

THE INDUSTRIAL CHALLENGE

An important application area for SiTek's position-sensing detectors (PSDs) is the high-volume photolithography machines, in turn used by the world's semiconductor manufacturers. To increase the resolution, and thereby push Moore's law forward, the photolithography process has over the years used light with shorter and shorter wavelength. With the latest decrease, from 193 nm down to 13,5 nm, the wavelength has reached the extreme ultraviolet (EUV) region and since 13,5 nm now is a wavelength standard for this industry it is important for SiTek to make sure that our products meet the requirements from our customers also in this wavelength region. It is therefore crucial to verify the products performance in context of radiation hardness when exposed to EUV.

WHY USING A LARGE-SCALE FACILITY

The 92 eV energy and photon flux required to, with a reasonable beam time, evaluate the radiation hardness up to the levels required by industrial applications is very hard to achieve and one of few ways to achieve it is by using a synchrotron.

HOW THE WORK WAS DONE

The radiation experiments were performed at the beam line SPECIES at MAX IV, optimized for 100 eV which is very close to the 92 eV needed for our verifications of performance at 13,5 nm wavelength. It has furthermore the high precision 4 axis micromanipulator with sub-µm resolution needed for the surface scanning measurements and a relatively small beam size, 5 µm x 25 µm. Together with the high 1E13 photons/second photon flux, SPECIES ensures the high intensity beam necessary to evaluate radiation hardness within a reasonable beam time. The connection into the beam line was done via a specially designed feed through. Since the detector itself measured the beam position it was possible to center the beam onto the detector before each measurement sequence and thereby create a reference point for the micromanipulator scanning. The radiation hardness measurement were done by irradiating lateral position sensitive detectors with 92 eV photons. Lateral position sensitive detectors with different designs such as N-I-P and P-I-N, using different kinds of implantations, annealing processes and passivating layers have been investigated.

THE RESULTS AND EXPECTED IMPACT

The measurements gave us a clear indication on the most promising combination of the different designs and parameters. The SPECIES beam line was a crucial tool in the identification of the best preforming sample and gave much needed insight in the radiation hardness of all samples.

The next step will be to take the best performing samples and finalize their design before moving on to production.

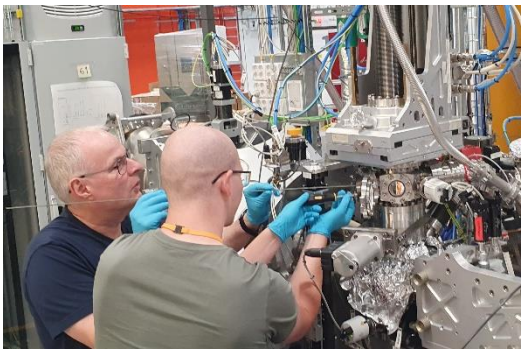

Figure. Gustav and Göran during the mounting process of the samples at SPECIES, using a design made to limit the pump time.

"The measurements at MAX IV have been crucial in the identification of our best preforming samples."
/Gustav Forsberg, SiTek Electro Optics

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