x lith
extreme lithography

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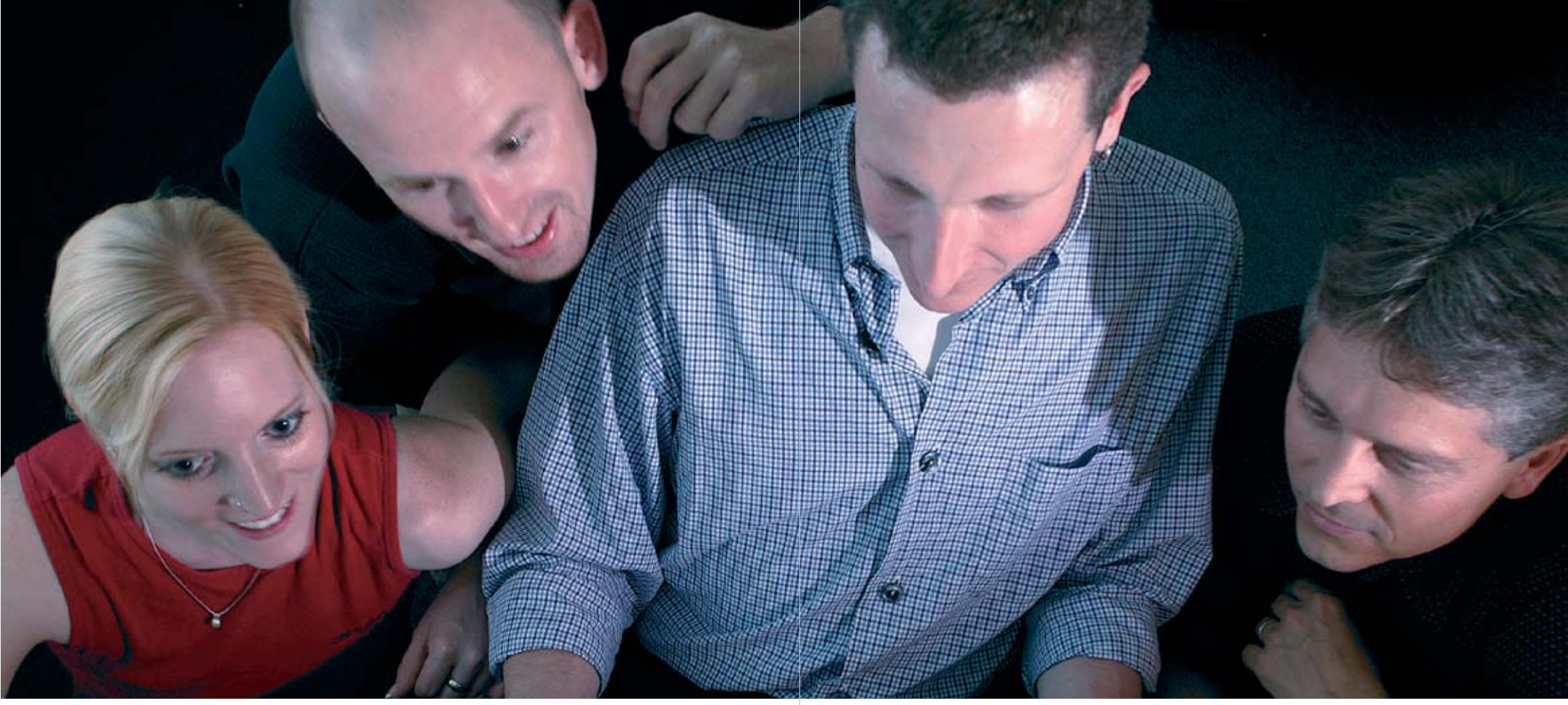
We know how
to write nanometer



extreme lithography®

xlith offers services and products related to pattern generation in the 10-250 nanometer regime using electron beam lithography.

Advanced microelectronics, photonics, nanotechnology - they all rely on high resolution e-beam lithography as the primary source for ultra-fine lateral patterns, generated directly on the wafer or on transfer media like masks, masters, templates or molds.

Moving from idea to device, at some point the transition needs to be made from CAD layout description to physical object.
E-beam lithography as a computer-controlled sequential writing process transfers designs from the virtual realm to the real world.
It uniquely combines ultra-high resolution, overlay performance and direct, computer driven pattern generation.

We are the first independent direct wafer write e-beam service provider. Our customers are nanotechnology start-ups and industrial research labs, universities, III/V-fabs and high-tech companies worldwide.

Founded in 1997 by Dr. Bernd Maile, xlith is built on more than 20 years of experience in ultra-high resolution e-beam lithography.

Over the years, we have contributed to the development of state-of-the-art e-beam tools and process technology. We have been involved in many research and engineering projects which have helped advance this fascinating technology further.

To achieve outstanding results xlith combines:

- state of the art electron beam equipment, additionally fine-tuned for optimum performance
- thorough theoretical under-standing
- in-house developed simulation and correction tools
- proprietary process technologies

We know how to write nanometer

electron beam writing

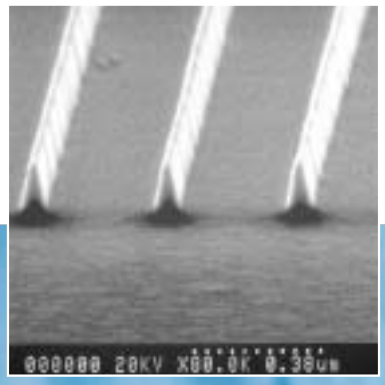
The main advantages of direct e-beam writing are:

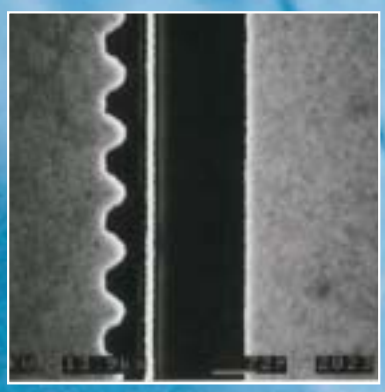
High Resolution
E-beam lithography reaches a resolution level unequalled by any other method. Lateral dimensions smaller than 10nm can be obtained.

Pattern Fidelity
Due to its intrinsically high resolution, excellent pattern definition can be achieved with appropriate exposure schemes.

Overlay to Existing Technology Levels
E-Beam patterns can be overlayed to existing features with very high accuracy. Registration signals from reference markers are used for this purpose.

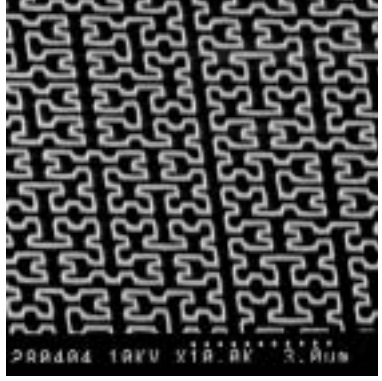
Fast Prototyping without Need for Mask Production
E-beam direct write is a computer-controlled sequential process. No pattern masters are required, making it the ideal tool for flexible generation of low volume prototypes.





xlith Substrate Flexibility
We have all the flexibility concerning substrate types and geometries. A selection of more than 100 substrate holders allows us to mount and expose virtually every substrate from tiny sample piece (typical in research applications) up to 6" wafers and mask blanks.
Substrate materials include:
- Si, GaAs, InP, SiC, GaN, Diamond
- Metals and Dielectrics
- Quartz / Fused Silica

By the way, we even demonstrated e-beam lithography and lift-off processing on fully functional CCD chips mounted in their 20 pin DIP ceramic package.



applications products and services

High Frequency Electronics
High frequency electronics has been the major driver and first production relevant application for direct write e-beam lithography. Gatelengths in the 100 nm range can be produced with good process latitude and yield. Relying on e-beam technology, GaAs and InP HEMTs deliver power gain cutoff frequencies well above 100 GHz. They are the crucial building blocks of advanced microwave monolithic integrated circuits (MMICs), being used in mobile telephone infrastructure and satellite communication systems. xlith has exposed thousands of III/V-wafers (2-4 inch) with more than 100 different designs for advanced MMICs and discretes.
Industrial customers with internal e-beam capability rely on xlith as second source with excellent surge capacity.

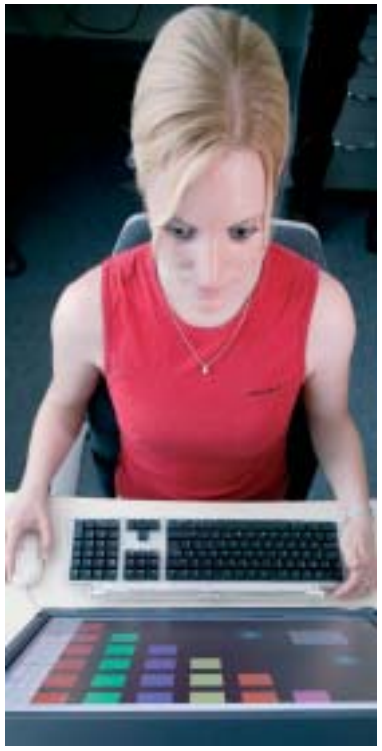
Photonics and Optoelectronics
Photonics and Optoelectronics involve the manufacture of devices that convert electrons to photons and vice versa. Fast progress has been made over the last years especially in monolithic integration of active and passive photonic components. Key elements in photonic designs are closely coupled waveguides, wavelength filters, Bragg gratings, and diffractive patterns. Their spectral and spatial performance strongly depends on the precision, reproducibility, and accuracy of pattern definition.

xlith serves customers in the photonics industry worldwide for applications and components like:
- fiber-optic communication systems
- photonic integrated circuits produced in InP, silica-on-silicon, SOI
- Bragg gratings, wavelength selective filters, mode converters
- add/drop multiplexers, Mach-Zehnder interferometers
- DFB laser gratings with excellent spectral quality
- synchronized DFB laser grating sets with ultra-high spectral accuracy for DWDM applications
- photonic crystals and ring resonators
- photonic band gap designs and waveguides
- diffractive patterns and wavelength selective mirrors
- synthetic holograms

Using proprietary hardware modifications and software modules, we can cope with the most demanding customer specifications.

Molds for Nano Imprint Lithography
In Nano Imprint Lithography (NIL), a template with nanometer features is pressed into a resist cast, creating a thickness modulation. Hot embossing and injection molding are two prominent variants of this technology. A third variant uses transparent templates and low viscosity, UV-curable monomeric resists.
xlith fabricates templates for Nano Imprint Lithography based on Si and Quartz / Fused Silica substrates.

Soft Lithography Masters
Soft lithography methods utilize elastomeric stamps, replicated from a nanopatterned master substrate. xlith fabricates high resolution soft lithography masters based on SOI substrates.



Nano-Devices and Mesoscopic Systems
Fundamental physical properties dramatically change when the length scale of a system approaches the de Broglie wavelength. High resolution e-beam lithography is the method of choice for preparing devices on the mesoscopic scale.
We have the experience and the ultra-high resolution processes to support your research project in this fascinating field.

Quantum Computing
Nanotechnology offers much more than increasing the density of conventional logic designs. It enables a new kind of computation using algorithms based on quantum principles. For its successful application outside of research laboratories, quantum computing requires mesoscopic engineering to avoid decoherence and assure qubits interact only with themselves.
E-beam lithography will pave the way for the development of quantum computational systems.

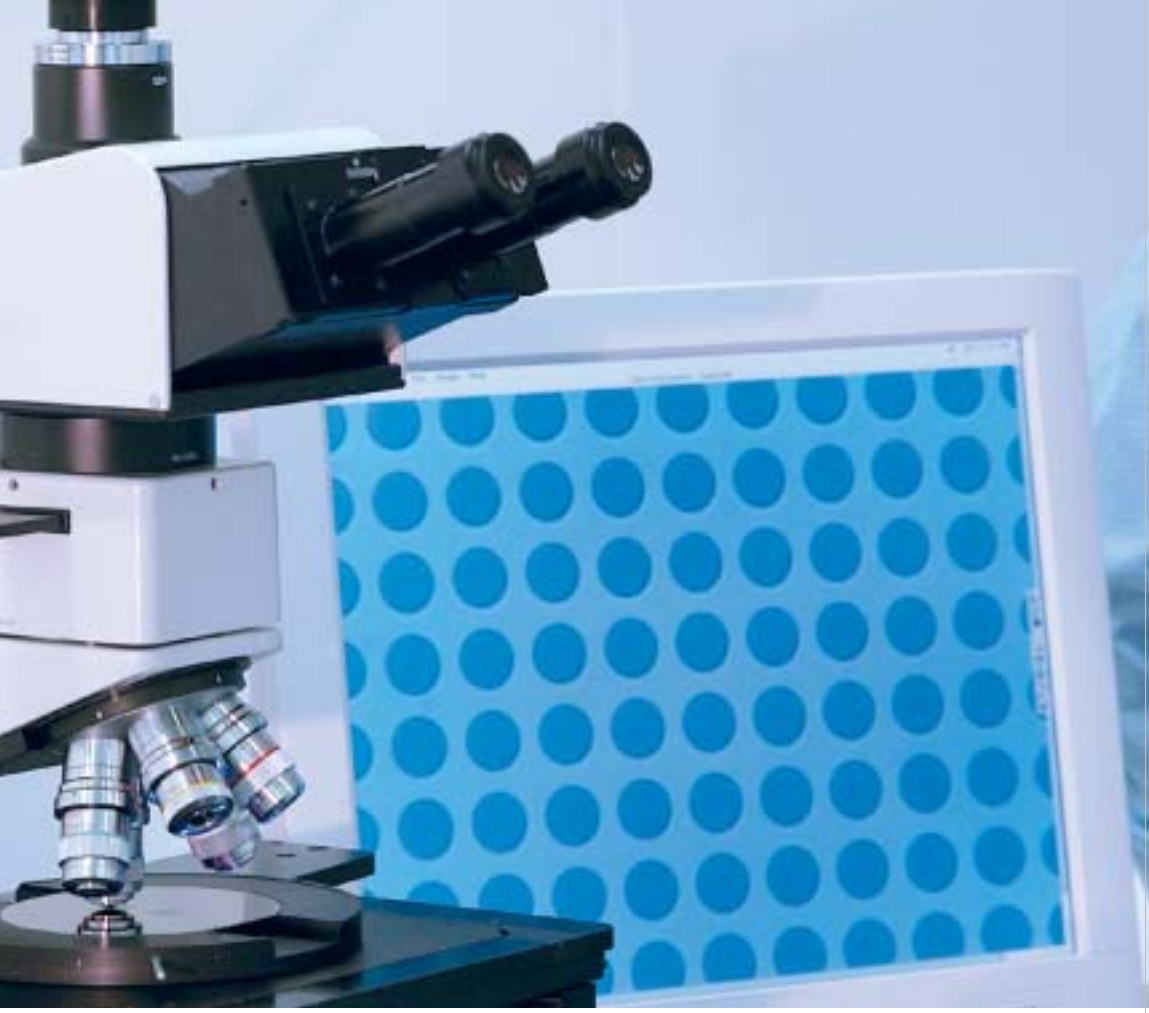
Application Studies & Research
Electron beam technology will continue to open new doors in device physics and technology.
We can help you accelerate this process by performing dedicated application studies and research projects.

Reference Standards for Nanometrology
We produce resolution test patterns, pitch and linewidth calibration standards for optical and scanning electron microscopes.

Specialty Masks
In terms of throughput, our high resolution vector scan e-beam systems cannot compete with the tools used in commercial mask-shops for the production of standard masks. For economic reasons, it makes no sense for us to expose mask pattern geometries above 400nm, which also can be achieved with a throughput optimized raster scan system. On the other hand, if higher resolution levels must be reached and pattern geometries get smaller and more complex, xlith comes into play.

For customers who could not be served by merchant mask shops we have fabricated specialty masks with features well below 100nm. If customer designs contain non-Manhattan patterns like e.g. waveguides in integrated optics, we can deliver specialty masks with pattern fidelities not achieved by mask shop equipment.
Quantum II is an ultra-high resolution test mask used for defect printability studies and benchmarking of advanced defect inspection systems.

For more details about Quantum II and our XLM40 high resolution binary mask technology, please visit us at **www.xlith.com**



our experience your success

From Prototype to Volume Manufacturing: stay with xlith
The bright perspectives and opportunities of nanotechnology have triggered a wave of start-up companies. Quite often their business model is based on a fabless approach. A typical success story reads like this:
feasibility study (@xlith) - prototype fabrication (@xlith) - volume production (@xlith)
Your advantage: no need to change critical production environments and re-develop process technologies due to growing product volumes.
If you need more - simply stay with xlith. We have the capacities you will hopefully ask for.
Needless to say - as volumes grow, prices go down.

Efficiently combining Nano, Micro and Macro
Many applications require lateral designs combining nano-patterns and structures on a more relaxed microscopic or even macroscopic scale.
Quantum functional devices need electrical connections to the outside world. Photonic designs often combine high resolution gratings with coarser auxiliary patterns. Customer designs for nano-imprint masters usually contain a high percentage of patterns in the 1...100µm regime.
We have methods to simultaneously create patterns ranging from the nanometer realm up to the macroscopic world on the same process level. There is no need for mix-and-match methods, often resulting in reduced process latitudes or loss of pattern definition.
We just do it with e-beam lithography, in a single process step. Highest quality, yet cost efficient.

IP@xlith
As a totally independent e-beam service provider, xlith is highly sensitive to the confidentiality of its customer's designs. Your design and process IP remains your property. Guaranteed.

fab@xlith
With an installed base of 3 high resolution e-beam systems in 2 completely independent cleanrooms we offer an extremely reliable, redundant and flexible service. Not to forget our surge capacity.

electrons@xlith
We are not just users of commercial e-beam tools. For more than 2 decades, xlith staff has developed proprietary hardware add-ons and software modules for improved system performance and reliability. We will never stop to push technology further. For the highest level of resolution, accuracy and throughput.