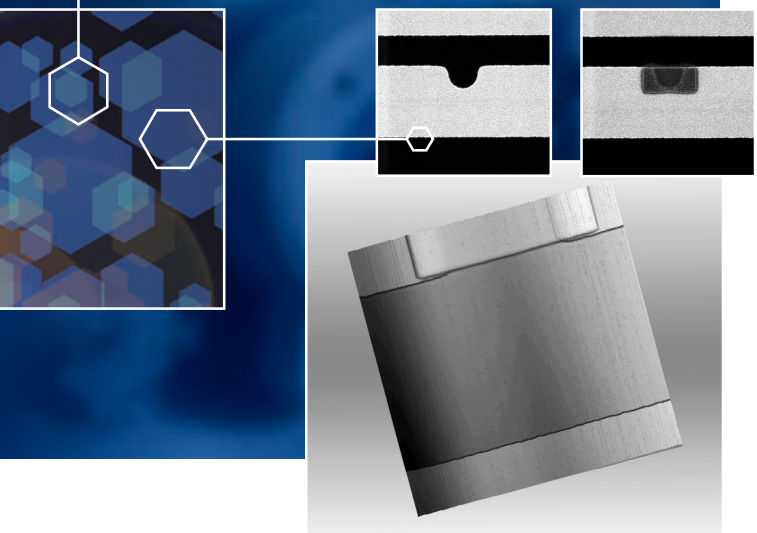
PRODUCT DATA

FEI COMPANY™



Accura 850

Advanced FIB Mask Repair Solution for 193 nm Lithography

The Accura™ 850 is an advanced focused ion beam (FIB) mask repair system designed for repairing defects on today's most complex masks including chrome, phase shift, alternating phase shift, and optical proximity correction (OPC) feature masks. This system enables advanced masks to get to production faster and with reduced costs.

- *Repairs defects on advanced masks, saving thousands of dollars and reducing delivery times to customers*
- *Offers unsurpassed 25 nm edge placement accuracy*
- *IntuitION graphical user interface provides ease of use*
- *Pattern Copy allows for complex repairs on OPC masks*
- *Reliably images and repairs embedded shifter masks*
- *Patented charge neutralization optimizes FIB performance*
- *Patented chrome removal process delivers clean, high transmission repairs*

Improve Yield and Cycle Time

As its name implies, the Accura 850 from FEI is the most advanced and accurate mask repair system available. Its proprietary gas processes, combined with unsurpassed placement accuracy, make it the ideal system for repairing advanced chrome and phase shift masks. The IntuitION™ graphical user interface and features such as Pattern Copy allow operators to recover even the most complex OPC feature masks. Unlike laser repair systems, the Accura 850 provides the flexibility of repairing both clear and opaque defects, and is the only system capable of repairing phase bump defects on alternating phase shift masks (APSM). This makes the Accura 850 the only total solution to all your defect needs. Today's advanced masks already cost tens of thousands of dollars and can be ruined by a single defect. The Accura 850 perfects these masks by repairing any defects, reducing costs and shortening delivery times to customers.

Clear and Opaque Defect Repair Capability

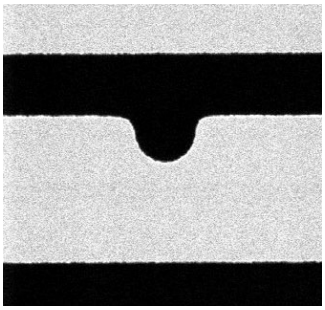
The Accura 850 uses precision focused ion beam (FIB) material deposition and removal to accurately repair clear and opaque defects on advanced binary chrome and phase shift masks. Through the use of a highly focused ion beam and FEI's patented charge neutralization process, the Accura 850 provides the critical edge placement accuracy required for advanced mask repair.

For clear defect repair, the FIB deposits an opaque carbon film where the absorber is missing to match the transmission of the mask. This resulting film is durable and unaffected by standard mask cleaning processes.

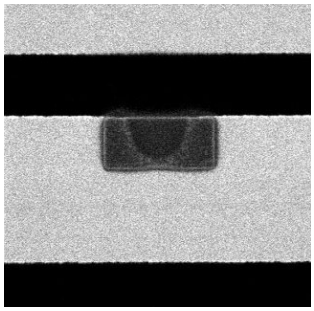
To repair opaque defects, the excess absorber is removed using FEI's proprietary gas-assisted etching (GAE) processes. Etchant gases provide high selectivity of absorber removal to the substrate. GAE thus provides precise control of the removal process to minimize damage to the surrounding features or underlying substrate.

Pattern Copy Software for Complex Repairs

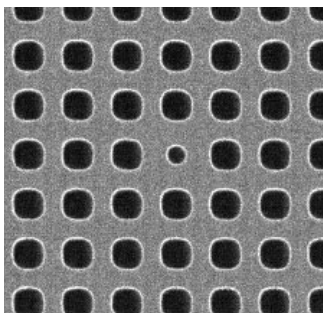
The Accura 850 is equipped with the most powerful and user-friendly Pattern Copy software available, allowing for complex defects to be repaired quickly and easily. This feature makes it possible to copy a known good area onto a defect site, so that multiple repairs are performed simultaneously with just one repair box. Through the use of a Cognex Vision sys-



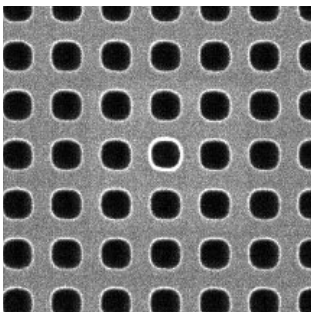
Clear defect repair: Missing chrome defect before repair.



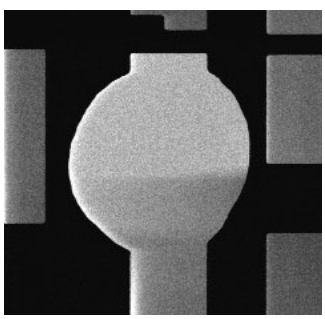
Chrome mask after it was repaired using carbon deposition.



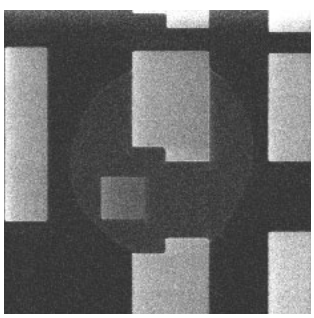
Opaque defect repair: MoSiON mask with obscured contact hole.



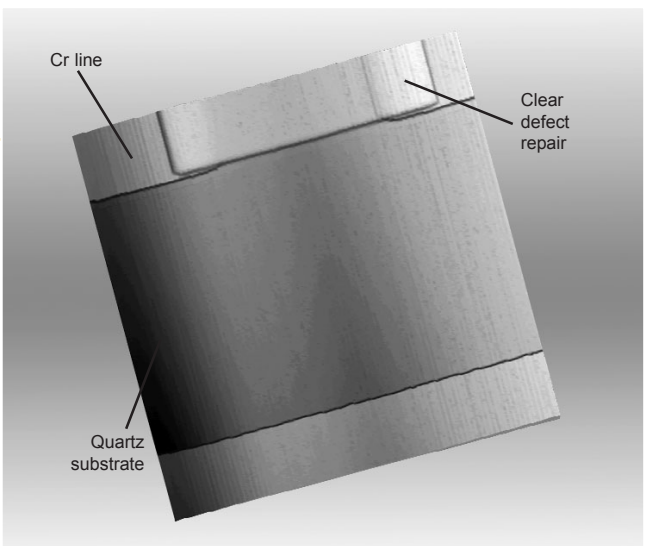
MoSiON mask after it was repaired using GAE.



Pattern Copy: Hidden isolated chrome defect before repair.



Chrome mask after it was repaired using Pattern Copy.



The combined technologies of the Accura 850 and the Stylus NanoProfilometer (SNP) offer a complete solution for advanced mask repair. The Accura provides superior FIB mask repair capabilities, and the SNP allows for the characterization of 3D structures; these capabilities are crucial to the performance of advanced masks required for subwavelength lithography.

tem with PatMax™ software, the Accura generates a bitmap image of the good area which is then aligned to the defect site. The user has the option to modify the bitmap, if necessary, or proceed with the repair. During the repair, the Pattern Copy software automatically determines what geometries are defective and need either opaque or clear repair.

Although Pattern Copy software can be used on any chrome or MoSiON mask, it is especially useful when trying to recreate serifs and other intricate features found on OPC masks. One of the difficulties with these masks is determining what a geometry should look like. Pattern Copy solves this problem by allowing the user to copy the known good area onto the defect area. With the benefits of Pattern Copy, it is no longer necessary to scrap masks with complex defects.

Embedded Phase Shift Mask Repair

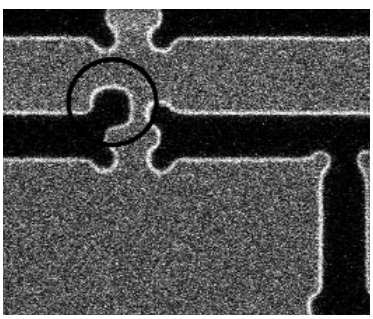
As lithographers try to squeeze every bit of resolution out of their steppers, more of them are using resolution enhancement techniques that can be provided by the mask itself. One of these techniques is to use embedded shifter masks, and one of the most common types is the MoSiON mask. The Accura 850 reliably images and repairs clear and opaque defects on MoSiON masks, providing transmission levels of greater than 95 % at 193 nm, edge placement accuracy of ±25 nm and minimal quartz damage.

APSM Phase Bump Repair

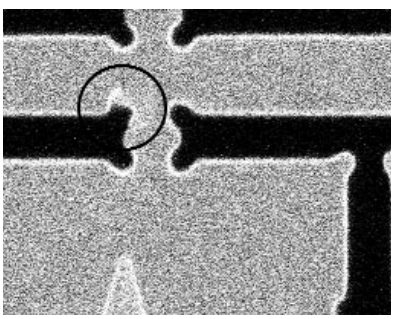
As lithographers try to print 0.13 µm and 0.10 µm lines using 193 nm light, it will become imperative to use strong phase shifting techniques, such as alternating phase shift masks. These masks are costly and difficult to manufacture, and include complex three-dimensional enhancement structures which makes their repair more difficult. One of the biggest concerns is how to fix a quartz phase bump defect. FEI has developed an innovative new phase bump software feature to help solve this problem. This feature enables the Accura system to interface with profilometer machines, such as the Stylus Nano Profilometer™ (SNP), to acquire topographical data about the defect. During the phase bump repair process, the defect is scanned by the SNP to generate a contour map of the phase bump defect. This map is transferred to the Accura 850, and after alignment a programmed scan strategy and variable dose mill are used to safely remove the phase bump.

New VisION™ column for High Resolution Multiplex Imaging

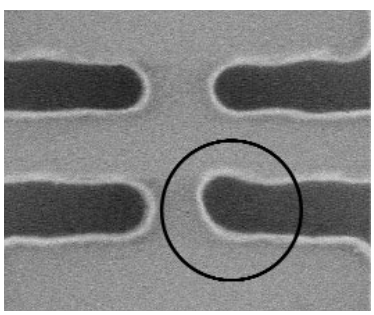
FEI's new VisION column provides greatly improved resolution and the imaging capability needed to find even the smallest mask defects. The microchannel plate (MCP) technology allows for multiplex imaging using secondary electrons or ions, and yields crisp, clear images of the mask surface. This allows for defects as small as 0.1 µm to be imaged, and also makes it possible for chrome, chrome oxide, MoSiON and alternating phase shift masks to be imaged consecutively, without changing image parameters.



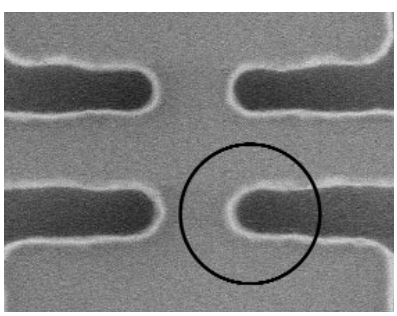
OPC mask repair: FIB imaging of defective OPC pattern (0.2 µm defect).



FIB image of repaired OPC pattern (the triangle was added to assist in finding the repair).



Scanning electron micrograph of printed defect.



Scanning electron micrograph of printed pattern after repair.

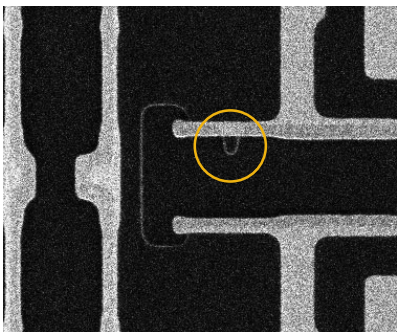
User-friendly IntuitION Graphical User Interface

The advanced imaging capabilities of the Accura 850 system are complemented by its easy-to-use IntuitION graphical user interface that guides the operator through the repair process in a step-by-step, intuitive process. The typical process involves loading a photomask into the loadlock and selecting the autoload function. The loadlock is automatically pumped down and the mask inserted into the process chamber. Meanwhile, the defect data is transferred from the inspection system to show the operator where the defects are located. After a simple locking routine, the operator can drive the laser interferometer stage to the location of the defect. The clear or opaque defect is then repaired using precision focused ion beam (FIB) material deposition or removal.

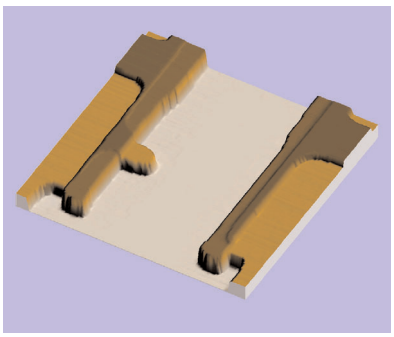
Complete Life Cycle Support

The customer is our number one focus at FEI. Your investment in the Accura 850 is fully supported by the industry leader in Structural Process Management. Our global network of applications experts and service personnel is ready to assist, and we are continually working to add value to your purchase through an aggressive program of product enhancements, software upgrades, and training—all to assure that your Accura 850 system will support your process management needs for years to come.

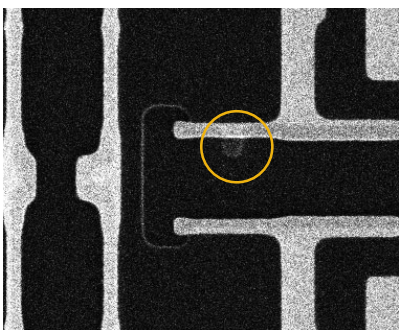
APSM Phase Bump Repair: Pre and Post Repair Images



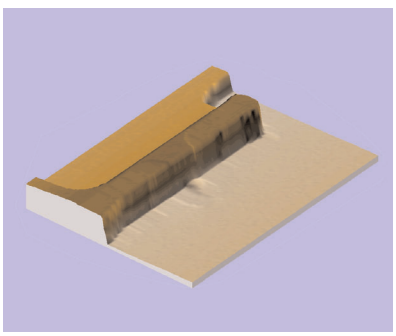
Pre repair image from Accura 850.



Pre repair image from SNP.



Post repair image from Accura 850.



Post repair image from SNP.

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