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CASE STUDY

Newport Corporation

Ultrafast photonics research requires ultrafast SEM results

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"The Phenom Desktop SEM is technically superior to other desktop SEMs"

As device dimensions are shrinking, new technology is needed to create and evaluate structures on the nanoscale. At Newport Corporation, Dr. Tommaso Baldacchini is developing technology for microfabrication and micromachining, creating structures with features on the scale of 100 nm. Scanning electron microscopy (SEM) is required to qualify microstructures on the micro and nanoscale. The Thermo Scientific™ Phenom Desktop SEM is a great time-saver for Dr. Baldacchini, providing SEM imaging and analysis in-house. The choice of the Phenom Desktop SEM was based on the scientific merit of the equipment and the knowledge that the technical expertise at Nanoscience Instruments will always be readily available for current and future applications.

Intentionally Designed for R&D

Traditional machining often employs laser ablation to cut or mill material. Ultrafast microfabrication and micromachining utilize short-pulsed lasers that cleanly create or cut 2D or 3D structures below the micron scale. Evaluation of these microstructures requires a SEM that provides high resolution with a large depth of field. Because there are many variables to test when incorporating new materials, many time-consuming trips to a nearby facility were taken for SEM imaging during development. It was quickly obvious that imaging microstructures on-site was imperative. After a complete evaluation of desktop SEMs comparing images of the same sample on different systems, Dr. Baldacchini chose the Thermo Scientific™ Phenom Pro Desktop SEM and noted it was "intentionally designed and engineered for research and development."

High precision microfabricated structures

Traditional methods of creating micro- or nanodevices often no longer apply, as dimensions are shrinking. Newport Corporation has developed a Laser mFAB that uses two-photon polymerization (TPP) to fabricate complicated structures. TPP is a printing technique that allows for true three-dimensional writing of polymeric microstructures with feature sizes as small as 100 nm. Newport Corporation has applied TPP to create devices previously impossible to manufacture with standard manufacturing techniques. Applications include microelectronics, photonics and biomedical devices for drug delivery.

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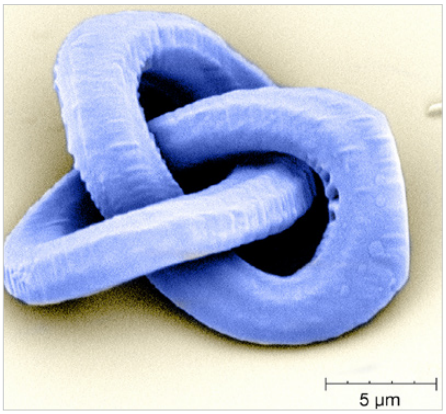
Examples of TPP-created structures are shown here. TPP is the only technique capable of making these kinds of objects at these length scales. A desktop SEM is the best instrument to reveal the surface features of these microstructures.

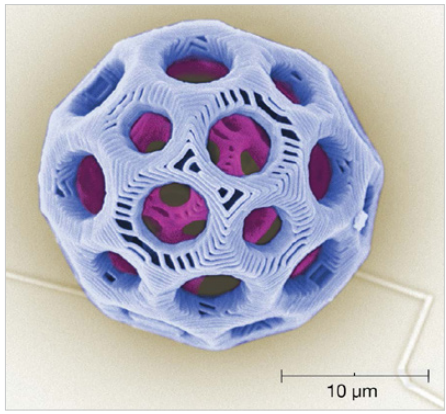
TPP is an additive process where material is added onto a substrate by means of laser induced photopolymerization. The Laser mFAB can also perform subtractive types of processes such as polymer ablation. Examples of removing materials on the nanometer scale are shown in the lower set of images.

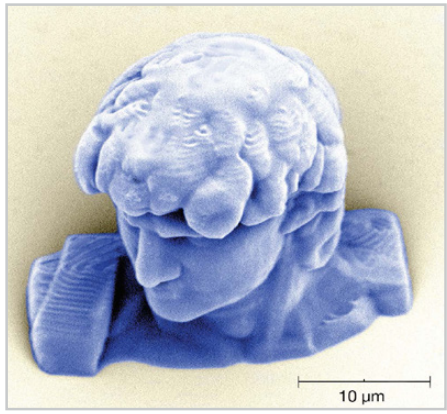
For this ablated sample, the Phenom Pro Desktop SEM was used to verify that the ablation lines were distinct and complete, with no debris or raised edges. Ultrashort pulsed lasers were used for this high-precision cold ablation with the Laser mFAB. The applications of materials polymers and dielectrics ablation are numerous, from photovoltaics to flat panel displays.

An SEM provides the depth of field needed to see the top, sides and bottom of these trenches. The Phenom Desktop SEM is required to image ablated structures on the micro- and nanoscale.

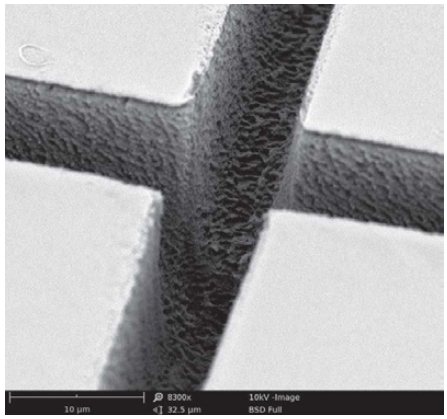


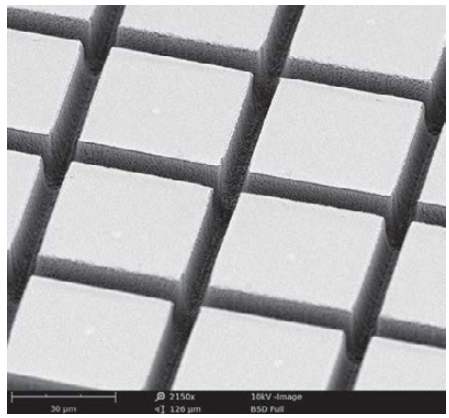
Dr. Baldacchini uses the Phenom Pro Desktop SEM to accelerate development and applications using the Laser mFAB at the Technology and Applications Center at Newport Corporation. Detailed micro-structures are created as shown here.





Colorized SEM images of a structure within a structure (left) and a miniaturized Michelangelo's David (right), microfabricated at Newport Corporation.





Phenom Desktop SEM images at 2,150x (right) and 8,300x (left) magnification of ablated samples.

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Newport Corporation is a leading global supplier of advanced technology products and solutions for scientific research. At the Technology and Applications Center in Irvine, California, Dr. Tommaso Baldacchini develops ultrafast photonics solutions for the microfabrication and micromachining R&D market.

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Acknowledgement

Special thanks to Nanoscience Instruments for the production of this Case Study.

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