

PERFECT BEAM FOR INNOVATIVE PHOTOPOLYMERIZATION

Axtra3D's revolutionary HPS technology relies on MKS measurement



Axtra3D was founded in 2021 with the ambitious goal to shake up the additive manufacturing industry. Only one year later, the company introduced its Hybrid PhotoSynthesis Technology (HPS), which is indeed transforming the market. HPS is the first coaxial system to allow the user to print fine features very fast and with superior surface finishing. The innovation is based on a photopolymerization processes with two light sources: a digital projector combined with a solid-state laser. Key to the HPS technology is perfect synchronization of the laser beam with the light. With MKS technology, the company achieves the ideal fit and relies on Ophir® measurement devices during the whole product cycle.

Overcoming the limitations of photopolymerization

Additive manufacturing offers enormous chances to quickly produce 3D parts. The technology has continually advanced since the first commercial Stereolithography Apparatus (SLA) burst onto the market back in the 1980s. In the meantime, layer-by-layer resin printing is available for everyday home use. But even with industrial high-end SLA solutions, there are still limitations in terms of manufacturing speed and surface quality. In order to overcome the speed limitations, Digital Light Processing (DLP) was developed; it allowed printing of an entire layer at once. A projector flashes images of each layer onto the resin, which cures when exposed to UV light. Even though the improvements brought by DLP technology are significant, there is still a lot of re-work needed on the finished piece. The printed parts must be washed, and the visible surface structure requires additional treatment. This is where Axtra3D comes in: The company, headquartered in the US with its innovation lab and production facilities located in Italy, was founded around an exciting patent portfolio with the goal to develop groundbreaking additive manufacturing solutions. Paul Spoliansky, founding member of Axtra3D and its chief revenue officer says: "Our technology puts an end to the trade-offs we've seen with other additive technologies. We enable our customers to print true to their CAD files without further re-work needed."

Products:

- Ophir® NanoScan™ 2s measurement device
- Ophir PD300R-3W sensor
- Ophir Starbright™ meter

Customer Market:

- Additive Manufacturing

Application:

- Development, quality inspection, field service

Advantages:

- Ophir NanoScan device measures large range of beam diameters
- Easy to setup and use
- Suited for measuring over the whole product lifecycle
- Accurate power measurement with PD300R-3W



Figure 1: The Ophir NanoScan beam profiler is key to ensure the reproducibility in the AM process.

Combining key technologies in the HPS light engine

The HPS technology recently introduced in the Lumia X1 3D printer includes both a digital light processor that prints the whole layer all at once and a diode solid-state laser that optimizes the structure of each layer in parallel. As with most high-tech solutions, while the result seems easy to understand, the journey there was very complex. Combining the digital light projector and its sophisticated optics with the laser requires perfect harmonization. Both devices need to emit light at the same wavelength: to ensure the high production standards, a maximum deviation of 30 μm is allowed between the two sources. Federico Iacovella, chief product and innovation officer at Axtra3D, explains: “We knew that it would be critical to know the laser parameters and beam shape, so we turned to MKS and their Ophir measurement solutions to get trustworthy measurements.”

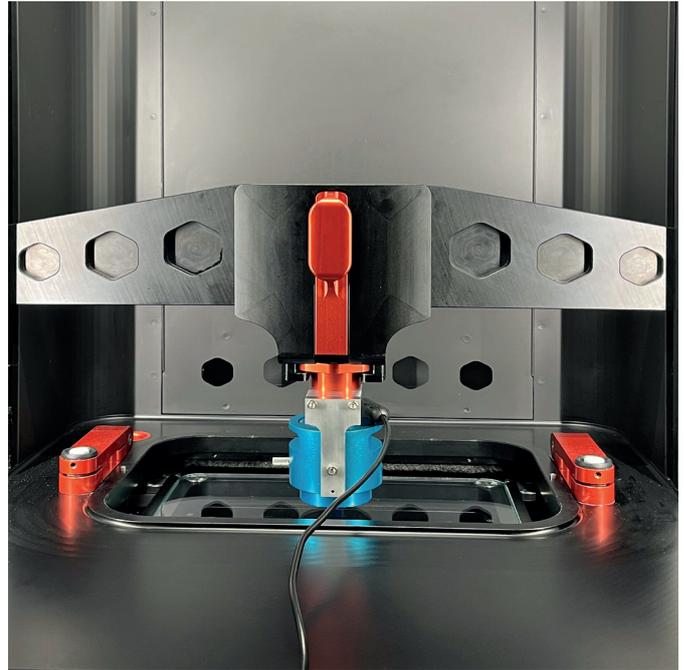


Figure 2: The measurement device is mounted with a bracket to measure the laser beam.

“We knew that it would be critical to know the laser parameters and beam shape, so we turned to MKS and their Ophir measurement solutions to get trustworthy measurements.”

Federico Iacovella
chief product and innovation officer at Axtra3D

Roundness of the beam is key

Ensuring the reproducibility of the additive manufacturing process in the long run is the priority when developing new technologies. Especially when it comes to industrial usage of 3D printers, the customers expect to get identical products with each print job. In order to assure the high quality of the HPS light engine, it is important to transparently check the relevant beam parameters including the beam shape – and not only in the R&D phase and during production, but also when maintaining the printers. With that in mind, Federico Iacovella was looking for an easy-to-use measurement setup that still delivered high-end measurements in each stage of the product life cycle: “We first tried camera-based measurement devices, but we realized that they weren’t suitable for our application in the field. This is why we decided to test slit-based measurement – with great success.”

The Ophir NanoScan beam profiler with its 9 mm aperture offered more flexibility with different beam sizes and is easier to manage. He continues: “Even if, in the end, what we want to measure is a really small spot size of only 45 μm , we start with a 7 mm beam. With the Ophir NanoScan device we gain full flexibility due its broad measurement range.” The PC-based instrument analyzes the laser beam spatial irradiance profiles according to the ISO 11146 standard. With the accuracy and stability of the beam profile measurement, beam size and beam pointing can be measured with a 3-sigma precision of several hundred nanometers. The HPS light engine needs a laser beam with a circularity of 90%; with the NanoScan measurement solution, Axtra3D is able to accurately measure the diameter and shape of the beam, whether in the clean room or in the customer’s production environment.

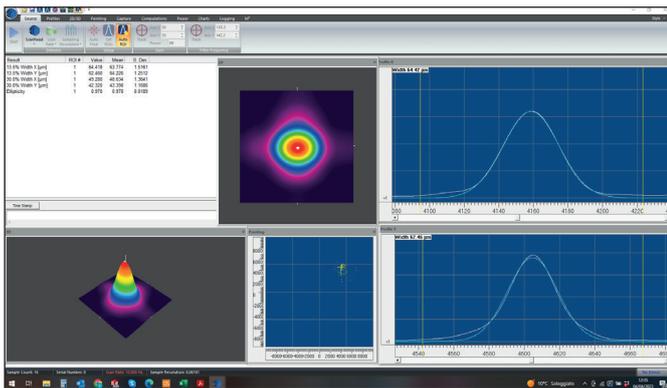


Figure 3: The PC-based profiler includes multiple graphical functions eg. 2- and 3D-graphs.

Managing power and energy

Another core topic with the HPS technology is to always apply a specific laser energy to polymerize the resin. As Axtra3D single-handedly manufactures each diode laser used in the Lumia X1 systems including the diode drivers, there is a strong need to analyze the power of each diode laser separately. Federico Iacovella clarifies: “We use the Ophir PD300-3W sensor to measure the single diode power and thus linearize the response current with the power of each diode. This way we can ensure that every diode laser will deliver the correct energy needed for each individual 3D-printing process. In terms of repeatability, those measurements are critical for both manufacture and the maintenance of the Lumia X1 systems.” Measurements of the PD300-3W sensor are displayed with a compact handheld Ophir StarBright power meter, which provides the user with sophisticated power- and energy-logging options, math functions and a variety of graphical choices.

New quality level in photopolymerization

Axtra3D’s HPS technology is groundbreaking for the further development of photopolymerization. Not only does the speed of the 3D printing processes surpass SLA printers and match high-speed DLP processes, by using the dual light sources, the technology eliminates the need for post-processing. Which to a great part directly relates to MKS measurement technology: “Ophir measurement devices are a substantial part of the product innovation, as measuring the laser parameters lays the foundations for the high quality of our 3D-printing technology,” summarizes Federico Iacovella.



Figure 4+5: Axtra3D relies on the Ophir NanoScan 2s scanning-slit profiler (left) and the Ophir PD300-R-3W sensor

“Ophir measurement devices are a substantial part of the product innovation, as measuring the laser parameters lays the foundations for the high quality of our 3D-printing technology,”

Federico Iacovella
chief product and innovation officer at Axtra3D



WHY MKS?

CRITICAL TECHNOLOGIES	PROVEN PARTNER	OPERATIONAL EXCELLENCE	COMPREHENSIVE PORTFOLIO
World-class technology and development capabilities for leading-edge processes	Recognized leader delivering innovative, reliable solutions for our customers' most complex problems	Consistent execution across all aspects of our business	Extensive offering of products and services for the Semiconductor, Advanced Electronics and Specialty Industrial markets.

MKS Photonics Solutions

MKS Instruments helps businesses solve their hardest technology challenges. A trusted partner of the world's largest electronics and industrial companies, we leverage leading-edge science and engineering capabilities to offer solutions that improve process performance and productivity for our customers. Spectra-Physics, Ophir, Newport and ESI are brands within the MKS Instruments Photonics Solutions division. Spectra-Physics combines groundbreaking laser technologies with deep application expertise to deliver industry leading lasers for precision industrial and scientific research applications. Ophir specializes in laser and LED measurement products, including laser power and energy meters and laser beam profilers. Ophir also provides high-performance IR thermal imaging lenses and optical elements as well as optics for CO₂ and high-power fiber laser material processing. Newport provides a full range of solutions including precision motion control, optical tables and vibration isolation systems, photonic instruments, temperature sensing, optical and opto-mechanical components. ESI systems deliver market-leading solutions for Flexible PCB laser processing, high-speed MLCC testing, and CO₂-laser-based systems HDI PCB and IC substrate manufacturing. MKS Photonics Solutions enhance our customers' capabilities and productivity in the semiconductor, advanced electronics and specialty industrial markets.