Super-polished Freeforms Optical Systems (SFOS) for industry and nuclear fusion

Abstract:

Currently industrial super polishing is applied only to flat optics, and spherical optics with surface radii larger than approximately 1m. The SFOS project will develop process-chains for manufacturing super- polished freeform optics (with radii down to 0.1 m) from design to super polishing, metrology and coating – for which there is currently no technology exemplar.

Countries involved

Application sectors
Aerospace, Automotive, Consumer goods, Medical applications

Research and innovation domains
Advanced manufacturing processes, Smart & adaptative manufacturing systems

Total cost in M€ (millions)
3.4 M€

Starting date
01/10/2023

Duration (in months)
36 months

Project leader
Fadi Atallah
fadi.atallah@zeeko.co.uk
Zeeko Ltd [PT]

Project participans
David Walker, Guoyu Yu, Hongyu Li, Trevor Walker, Fadi Atallah and Richard Freeman

RATIONALE OF THE PROJECT

To deliver a world-first, IP-protected, environmentally sustainable, industrial, free-form optical manufacturing solution, meeting stringent requirements for high-power laser systems, next-generation photolithography, and other challenging applications in industry and science.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

The This project will design and build a technologically disruptive commodity scale industrial process for the manufacture of complex freeform optical surfaces, for which there is rapidly increasing global advanced manufacturing demand and no existing solution. Using two highly complex sector demonstrator applications – nuclear fusion and high-power lasers – the output will be a novel, and industrially ubiquitous advanced freeform optical manufacturing process to accurately produce free forms down to a 100 mm radius of curvature. The current state of the art for which is limited to flats and spheres >1m ROC.

MARKET POTENTIAL

For semiconductors, Moore's law says that, 'the number of transistors on computer chips doubles approximately every two years'. To continue to achieve this requires ever-smaller feature-sizes, the limiting factor being optical diffraction in the photolithography optics. This demands evershorter operating wavelengths – extreme ultraviolet (EUV) and ultimately X-rays. The consequence is ever-tighter optical tolerances, with close parallels to high-power laser systems. Projected growth in the global photolithography equipment market is a CAGR 9.1% from $11.6Bn in 2022.

IMPACT POTENTIAL

The project's end-user benefits comprise simplified optical systems, and radically enhanced functional performance, serving demanding applications. The global advanced optics market is projected to grow at a CAGR of 9.6% from $250B in 2021. Open-source market information specifically for freeforms is not readily available, but given their advantages, they will undoubtedly capture an increasing share of the above market, which we estimate at 4% by 2028.