



WP5: Monitorization system for DLIP setup

Public day – 23/11/2021 Clovis Alleaume - AIMEN Johannes Ziegler - IRIS





General introduction

This presentation will focus on the monitoring system developed within the PROMETHEUS project:

- Two systems were developed, both based on the diffraction of light principle.
- One focus on O^{th} order at different wavelengths: scatterometry technic \rightarrow Aimen
- The second measure different diffraction orders for a single wavelength: diffractometry \rightarrow IRIS
- Depending on use case (material, pitch...) and the end-user, one, the other, or both setup can be used.





AIMEN - Asociación de Investigación Metalúrgica del Noroeste

One of the main Spanish R&D centre:





- Workforce of 200+ engineers & technicians
- Private Centre supported by industry
- 112 Associated Companies
- 3 buildings located in Porriño
- 5 national business offices
- More than 800 industrial clients.
- More than 60 R&D Projects by year















Capacities & Application areas



11/25/2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825503 – PROMETHEUS





Introduction about Aimen setup

- Process monitoring and quality control is an extremely important part of the laser surface texturing fabrication.
- With the PROMETHEUS system, the fabrication process will be monitored live with novel closed-loop technologies to correct any process deviation in an innovative way.
- This ensure the high yield of our system.





About diffraction

- Scatterometry is a technic used in optical lithography to verify the correct fabrication process of microchips.
- It is based on the diffraction and reflection of light when a periodic pattern is illuminated.



Diffraction principle: A periodic pattern (a) will separate the light into different diffraction orders (b). Light distribution depends on the pattern shape/properties.





Scatterometry principle



- A) Surface with a periodic pattern engraved
- B) By illuminating the sample, the Oth order is measured for different wavelengths and a spectrum is obtained
- C) On the other hand, a databased is built, where different pattern shapes and their associated spectrums are stored
- D) By comparing the measured spectrum with the database, we can find the pattern shape/properties





Application in PROMEHTEUS

 A scatterometry setup has been built during the PROMETHEUS project



 Different textures create different diffraction patterns





This project has received funding from the European Union 5 monzon 2020 research and innovation programme under gram agreement No 825503 – PROMETHEUS





Error detection

- Different textures were created with process deviations
- Their spectrum was measured at different location for Oth order
- A database was created with the results



ield	What was done
Ref	Reference field: on-target texturization process
A1	Loss of working position: positive z direction
A2	Loss of working position: negative z direction
B1	Change in period: bigger
B2	Change in period: smaller
C1	Laser power change: increased
C2	Laser power change: decrease
D1	Mechanical vibration: large
D2	Mechanical vibration: small









Machine learning and classification

- Based on the previous measured spectrums, a Machine Learning algorithm was used to classify the textures.
- Measurement are collected during the process to verify that everything is correct
- Failure modes can be identified with confidence interval between 80% and 100%.
- If a failure is identified, it will be communicated to the machine in real time, allowing for correction if possible.
- This will allow for process close loop control and texture validation.







Integration

- A dedicated setup has been mounted and tested at laboratory scale
- This final setup will be integrated inside the Prometheus prototype



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825503 – PROMETHEUS and from the "Photonics Public Private Partnership" www.photonics21.org





Conclusion for AIMEN

- With this new and innovative setup, we can monitor the texturization process in real-time.
- This close-loop system will ensure a maximum yield.
- Lab test are extremely promising, integration will start soon