Multilayer Mirror Sample Holder with Cooling

SDSU San Diego State University

ASML

norrim|mirror

Project Overview

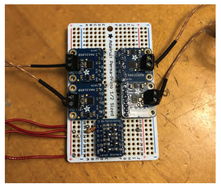
Background:
ASML is the leading provider of EUV (extreme ultraviolet) lithography equipment used in the production of advanced, semiconductor chips worldwide.

As part of troubleshooting, research, and development, ASML employs a heated vacuum chamber to simulate the various operating conditions where the Multilayer Mirror samples are used.

Problem Statement:
Create a water-cooled baseplate capable of holding a variety of mirror shapes and sizes at 30°C - 50°C while exposed to a maximum temperature of 300°C under vacuum.

Manufacturing

Soldering Lead Pins



Perfboard Circuit

3D Printed Housing

Cutting Stock Material

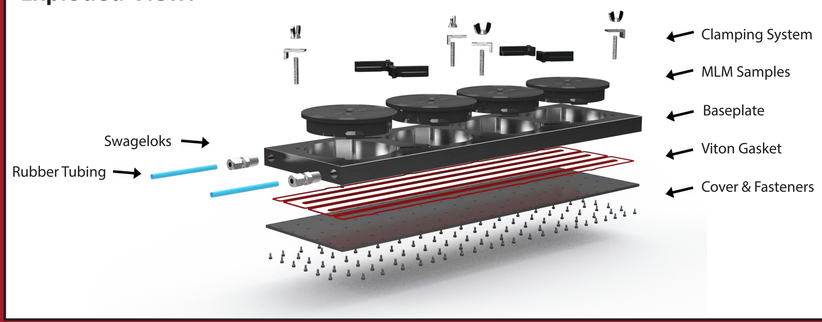
Machined Baseplate

CNC Milling Custom Clamps

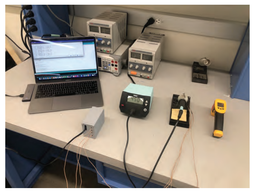
CAD Models

3D Render:

Exploded View:



Testing



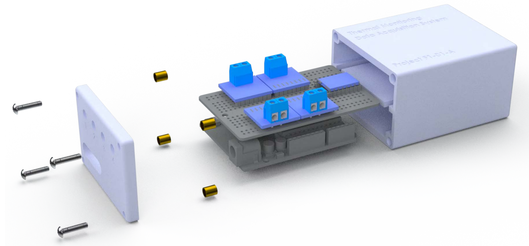
Data Acquisition Validation

Heat Resistance & Leak Check On Campus

Full System Validation On Site at ASML

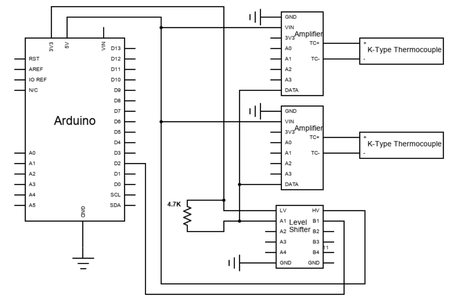
Data Acquisition

3D Render:



To monitor mirror sample temperatures during testing, a data acquisition system was created using the MAX31850 breakout board and an Arduino microprocessor. This allowed for all temperature-related testing to be conducted on-campus before being verified with ASML on-site.

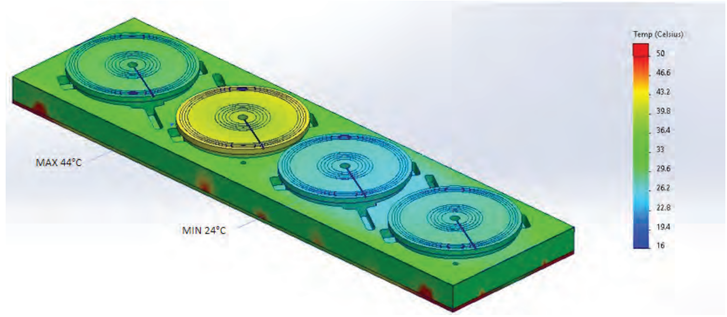
Wiring Diagram:



Thermal Analysis

Test Chamber Boundary Conditions:
18 LPM of 16.5°C cooling water is supplied through a ø12.7 mm inlet.

Convection Coefficient of 300 W/m²K assigned to all inner surfaces.
Heat Power of 3000 W assigned to all exposed surfaces.
Constant Temperature of 300°C assigned to chamber walls *(not shown).*



The thermal simulation shows a sample surface temperature range of 24 °C to 44 °C. This satisfies all thermal design requirements at maximum test conditions.

Gasket Design:
Torque required per fastener was calculated using compression curves.

Team Members

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Lead Engineer

Brenden Funke
Procurement & Research Engineer

Jorge Pineda
Supply & Finance Engineer

Andrew Preisler
Design & Manufacturing Engineer

Aaron Ramirez
Quality & Test Engineer

Acknowledgements

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ASML:
Joe Bendik - Project Sponsor
Tony Balanza - Test Chamber Specialist

SDSU:
Dr. Scott Shaffar - Project Advisor
Mike Lester - Manufacturing Assistance
Selena Jarin - Purchasing Assistance

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