HVac

Demonstration of Additive Manufacturing for Large and Complex Shaped Vacuum Chambers by Plasma Metal Deposition (PMD®)

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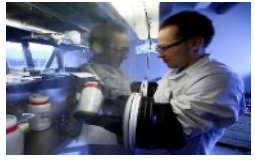
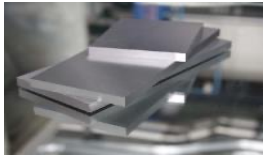

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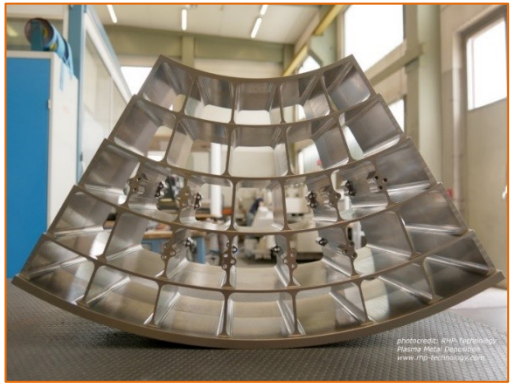
Project Team

An I.FAST partner that has demonstrated successfully the manufactuirng complex space-related structures by PMD.

An SME well-known in plasma welding field and also as a provider for plasma-based additive manufacturing systems (PMD).

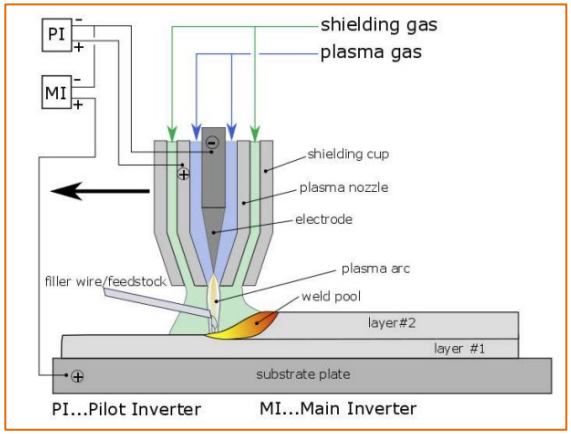


Component of ESA's Athena X-ray telescope manufactured by PMD®

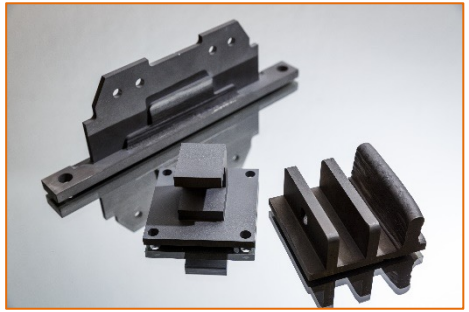
M3DP, large AM machine for PMD produced by SBI

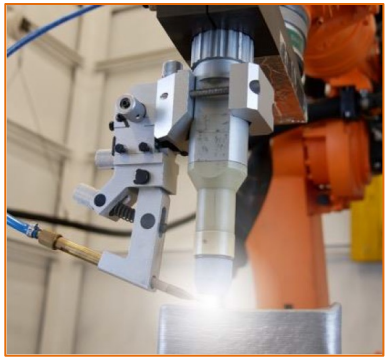
Technical background

- **Plasma Metal Deposition** (PMD®) is an AM process suitable for the production of large near-net shape components;
- Accelerator science and technology requires several **vacuum chambers** of various sizes and shapes;
- PMD has the potential to be used in the manufacturing of vacuum chambers, with **reduced raw material usage** and complex design.



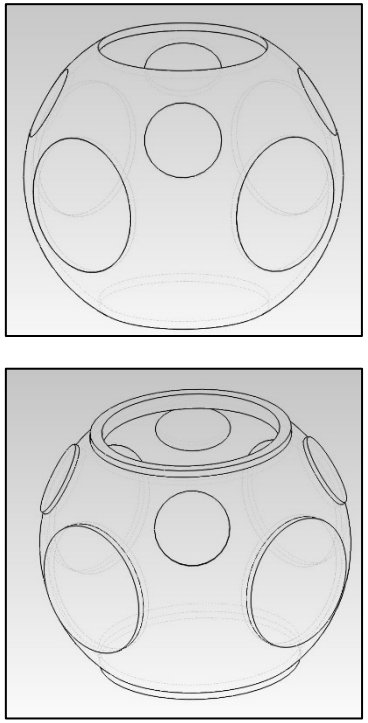
PMD
PLASMA METAL DEPOSITION





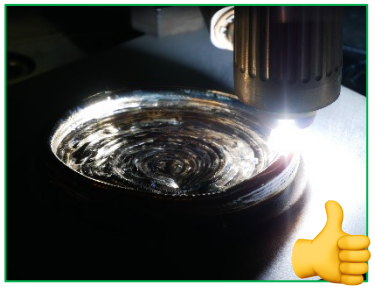
Aim of the HVac project

- **Design** generic vacuum chamber models capable of highlighting the manufacturing potential of PMD
  - Envelope of around **450 mm**;
  - Implement features such as flanges with arbitrary sizes and positions.
- **Manufacture** vacuum chambers in both sub-scale and full-scale sizes
  - Implement the use of **Titanium** alloys as a material for large vacuum chambers.
- **Test** the produced vacuum chambers with respect to their performance and geometry
  - Both material- and application-related tests.



Preliminary vacuum chamber designs

Benefits brought by the project



- Reduction of **material waste**
  - Near-net shape - at least 30% less waste.
- Reduction of **manufacturing steps**
  - PMD consists of three steps: tool path generation, building and machining;
  - No multiple welding operations for flanges needed.
- Reduction of **stock materials**
  - PMD requires only wire and building platforms;
  - E.g. flanges are manufactured by additive+substrative manufacturing.
- Reduced weight and operations enable the use of cost-prohibitive materials
  - E.g. Titanium.

Pressure vessel produced by PMD, with machined flange

Timeline

- 12-month project
- 03 work packages: *Design*, *Manufacturing* and *Testing*

Work package	Partner	M01	M02	M03	M04	M05	M06	M07	M08	M09	M10	M11	M12
WP1 - Design	**RHP, SBI**												
WP1.1 - Design of vacuum chamber	RHP, SBI												
WP1.2 - Tool path generation	RHP, SBI												
WP1.3 - Machine adaptation	SBI												
WP2 - Manufacturing	**RHP**												
WP2.1 - Manufacturing of subsize model	RHP												
WP2.2 - Manufacturing of full-size model	RHP												
WP2.3 - Finishing of vacuum chamber	RHP												
WP3 - Testing	**RHP**												
WP3.1 - Testing of vacuum chamber	RHP												
WP3.2 - Technology assessment	RHP												
WP3.3 - IP analysis and IP protection	RHP												

Budget

- Total budget: 100.000 Euro
  - *RHP: 75.000 Euro (material costs, personal costs, third-party testing, finishing)*
  - *SBI: 25.000 Euro (machine adaptation, personal costs)*

Deliverables

1. Design of chamber and detailed manufacturing plan [M04]
2. Manufacturing report [M09]
3. Manufacturing and testing of vacuum chamber [M12]

Expected development

- **Current:** TRL4
  - Technology has been validated in the lab environment
- **Expected:** TRL5-6
  - Manufacture and validation of a PMD‘ed vacuum chamber in an industry-relevant enviroment; integration with other devices, multiple bake-out cycles.

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