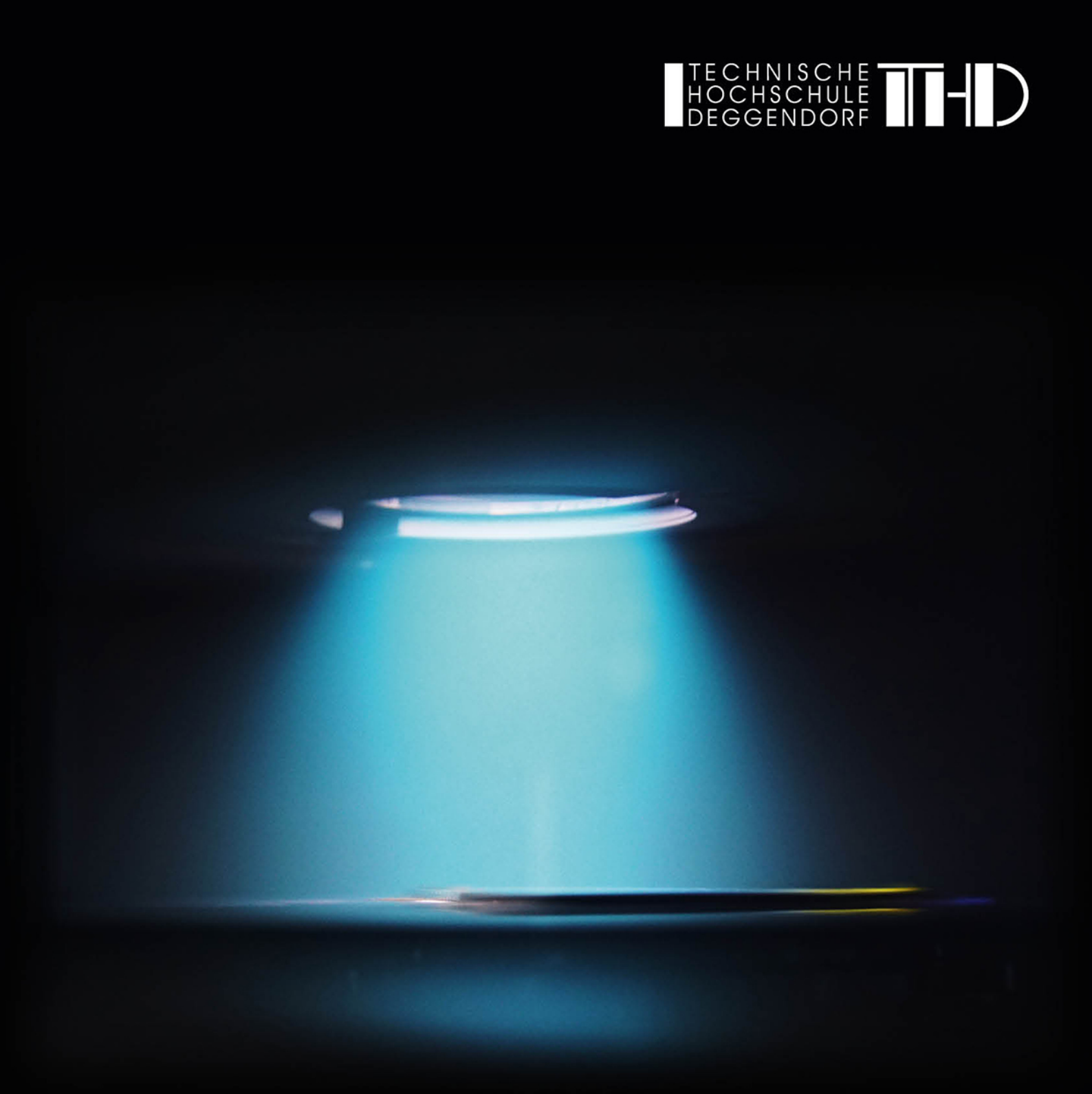
TECHNISCHE HOCHSCHULE DEGGENDORF



UCM4SPACE

WE COAT CARBON FIBER REINFORCED POLYMER MIRRORS WITH PLASMA TO PAVE THE FUTURE OF SATELLITE TELESCOPES.

Weitere Infos

Abstract

Project title:

UCM4Space - Ultralight CFRP Mirror for Space Telescopes

Introduction:

The usage of carbon fiber reinforced plastics (CFRP) for space telescopes has many advantages like its light weight, high Young's modulus and low thermal expansion. One problem which still needs to be overcome for the use as high quality optical mirrors is its minimum achievable surface roughness.

The international consortium of the UCM4Space project is designed in such a way that the fabrication of the CFRP structure of the mirror including a replication technology is carried out in Japan. The German partners are responsible for the design of the mirror, the design and fabrication of a highly rigid structure for measurement and the final finish of the mirror surface.

Aim:

The goal of this project lies in the fabrication of an extremely low roughness of the CFRP mirror of less than three nanometers. In order to achieve this accuracy, research is being carried out at the Technologie Campus Teisnach Sensorik (TCTS) for applying various brittle hard ceramic layers onto the CFRP mirror surface. This shall achieve a better polishability in contrast to the soft resin of the CFRP. The coating is carried out in a new pulsed laser deposition (PLD) machine allowing for substrate up to 350 mm in diameter to be coated.

Method:

In the PLD process, a highly energetic laser shoots at a ceramic material of the desired coating composition. The ceramic material is evaporated and a ceramic plasma is created. Because the process is done at vacuum, the plasma can travel to the CFRP mirror and condensate as a thin film on the surface. The deposition does not require a heated substrate and thus, the mirror is not getting harmed.

Result:

Different materials were tested and Al_2O_3 was found to be a promising material for the deposition onto CFRP. It does not change the nano-roughness of the CFRP surface. Only a form deviation because of an outgassing in vacuum takes place. This can be counteracted by leaving the CFRP substrate in vacuum for over 24 hours and a pre-polishing step prior to the deposition.

The scale up of the pulsed laser deposition process from smaller CFRP substrates onto a real demonstrator of the real 300 mm CFRP mirror shows first promising results.

Project participants:

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Project partners:

German partners:
Technologie Campus Teisnach Optik (THD)
ECM – Engineered Ceramic Materials GmbH

Japanese partners:
Techlab Ltd.
Kanazawa Institute of Technology (KIT)
RIKEN Centre for Advanced Photonics

Funded by:
Eureka/AIF/ZIM Projekt UCM4Space „KK5108101JO0“

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