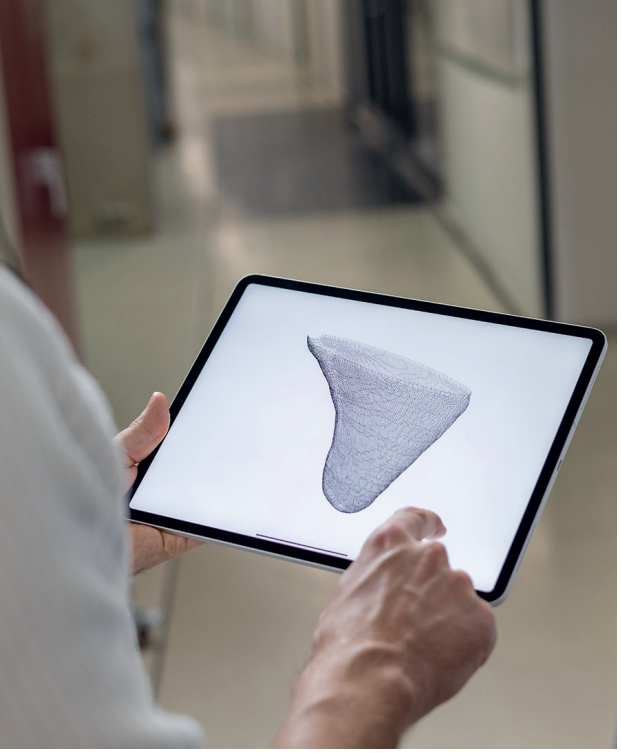

1 Analysis of steam capillaries from synchrotron data, © TRUMPF.
2 Laser-beam welding with green laser, © TRUMPF.

In-situ analysis of laser processes using synchrotron radiation at DESY

Laser-based processes can play a significant role in fabricating sensitive components for fuel cell and battery technology since their energy input can be flexibly and precisely adjusted. By using synchrotron radiation, research can investigate these laser beam processes in-situ with high temporal and spatial resolution to gain precise insight into the fundamental phenomena of the molten and vapor phases.

Implementation and application

At the Deutsches Elektronen-Synchrotron DESY (German Electron Synchrotron) in Hamburg, a mobile and modular setup can be used for investigating laser-based manufacturing processes. With this platform, laser beam sources of different types and wavelengths (fiber, disk, ring mode or ultrashort pulse lasers) and optical systems (scanner-based and fixed optics) can be modularly interchanged to conduct laser beam welding, cutting and drilling experiments. Fraunhofer ILT is using synchronized process control with optical and acoustic sensors to develop more detailed algorithms for process evaluation.

Basic transfer to industry

The setup developed here is used as a tool to study the following physical dynamic process properties:

- Spatial distribution of energy deposition on the material surface
- Influence of the laser wavelength on the material-laser interaction
- Geometry of steam capillary and melt pool
- Melt pool dynamics and flow profiles

In the course of very complex basic research, Fraunhofer ILT is serving as a pioneer to help industrial partners gain access to DESY on a service basis. In this context, the existing experimental setup, including existing beam sources and optics, can be used within the framework of a bilateral collaboration to generate new or extend basic findings for industrial applications.

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