

## Ultrafast Laser Structuring of Electrodes for Lithium-Ion Batteries

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**Abstract:** Laser technologies and processes are increasingly being used in lithium-ion battery (LIB) manufacturing and related application-oriented research and development. While laser welding is already well established in battery module production and high-speed electrode cutting is increasingly being integrated into production lines, ultrafast laser structuring of battery materials is on the verge of prototype implementation and has enormous potential to significantly influence the overall efficiency of LIB production and the electrochemical performance of next generation batteries. The development of novel electrode concepts via laser structuring of electrodes has been initiated as a new research field at KIT, which has already met with a broad response and is being imitated internationally in the field of research as well as in industrial pre-development. Laser structuring of electrodes is used to set specific electrochemical properties in batteries. Battery lifetime, fast charging capability, and battery safety can be significantly enhanced. The 3D electrode concept developed has improved thick-film concepts for high-energy cells to such an extent that user-friendly charging and discharging rates are now possible, i.e., high-energy and high-power battery operation can be realized at the same time. The presentation gives an overview of the current state of development work at KIT in the field of 3D batteries and an outlook on process upscaling for future industrial use.



**Prof. Wilhelm Pfleging** is Head of the Laser Materials Processing Group at the Institute of Applied Materials (IAM-AWP), which is part of the Karlsruhe Institute of Technology (KIT). He received his Ph.D. in Physics from the University RWTH Aachen University (Germany) at the Fraunhofer Institute for Laser Technology. He has published more than 200 peer-reviewed articles in scientific journals, books and

conference proceedings. His research focuses on the development of laser-assisted processes, analytics, and fabrication of advanced lithium-ion batteries and related energy storage materials. Since his habilitation in 2019 and his professorship in 2022, his teaching field at the KIT university is "Laser Technology".