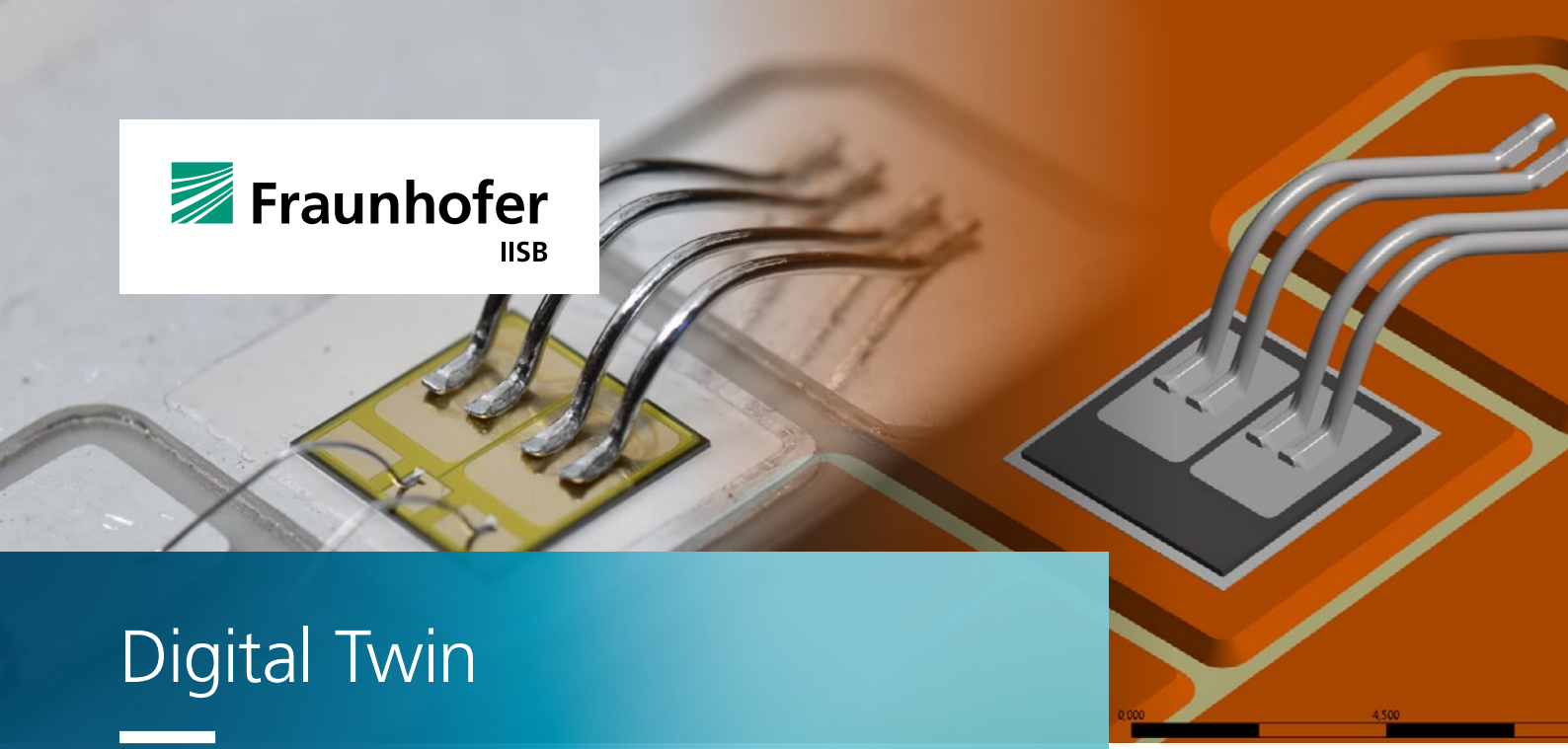
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Digital Twin

For Power Electronics Applications

Real product vs Digital Twin
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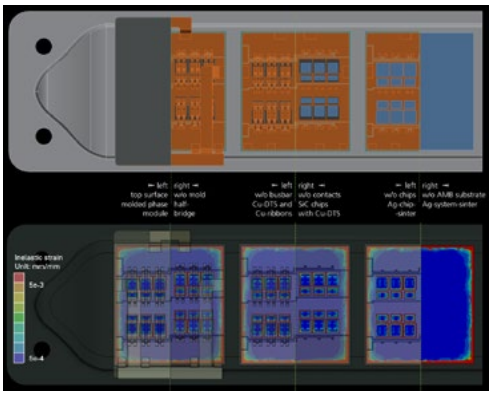
We develop Digital Twin solutions tailored to power electronic systems. By combining experimentally validated simulation, comprehensive lifetime analysis, and physics-informed machine learning, we support our partners in understanding and improving product reliability. We work closely with industry to bridge the gap between research and application.

Full Lifetime Stress & Strain Monitoring

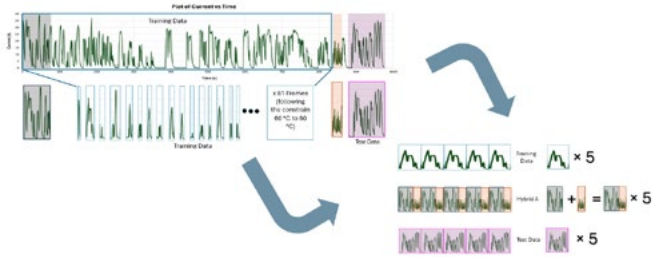
- Electro-Thermo-Mechanical simulation from manufacturing to operation
- Coverage of the complete process chain: sintering, molding, testing
- Virtual representation of reliability tests (PCT, TST, mission profiles)
- Identification of critical locations and failure mechanisms
- Assessment of damage accumulation over product life

Physics-Informed Machine Learning

- Integration of physics with data-driven approaches
- Significant acceleration of computational times
- Preservation of physical consistency and interpretability
- Applicability to real-time monitoring scenarios
- Efficient scaling across different designs and load conditions



Simulated strain history:
sintering → molding → PCT/TST/Mission Profile



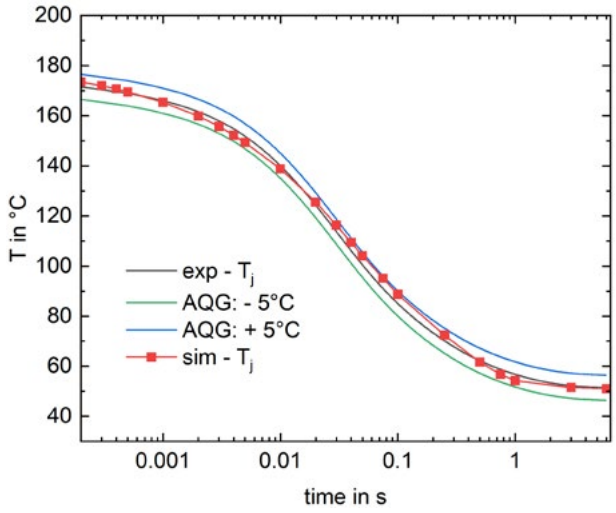
Mission profile sampling for training

Task	FEM Runtime	Surrogate Runtime	Speedup
Electo-thermal simulation	3-4 hours	<10 seconds	~10^3x
Mechanical simulation	10-12 hours	<30 seconds	~10^4x

Speeding-up using physics-informed surrogate model

Validated Simulation Models

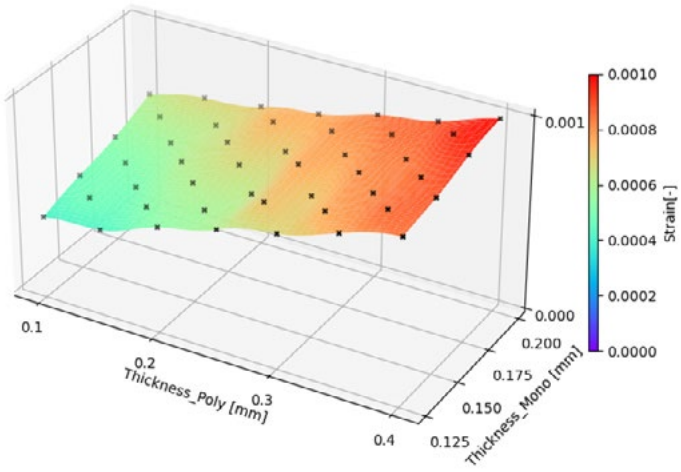
- Development of high-fidelity FEM models for electro-thermo-mechanical analysis
- Systematic cross-validation with experimental measurements
- Accurate calibration of material and interface properties
- Solid foundation for reliable lifetime predictions



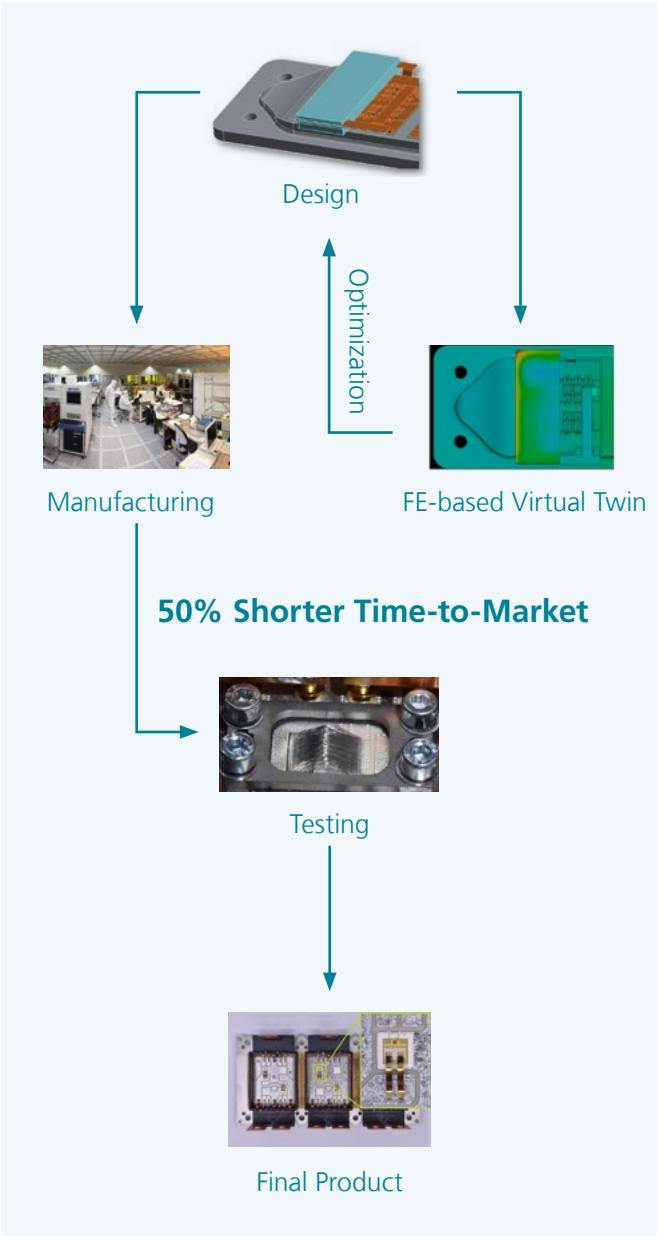
Calibration of thermal model based on measured cooling curve

Sensitivity & Optimization Analysis

- Identification of critical design and material parameters
- Quantification of parameter influence on reliability
- Systematic design space exploration
- Multi-objective optimization



Influence of different chip thicknesses on sinter layer strain



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Contact

Dr.Jürgen Leib
Testing and Reliability
Tel.: +49 9131 761 615
juergen.leib@iisb.fraunhofer.de

Fraunhofer IISB
Schottkystr.10
91058 Erlangen
Germany
www.iisb.fraunhofer.de