

Material Data Source

COMSOL Syntax Check

Code Translation

Compilation to mph file

Import to Material Library



# Software Interface for Material Database to COMSOL® Material Library

AdHyBau is a joint project to develop **additive hybrid materials** for use in the **cryogenic hydrogen environment** of an **aerospace electric powertrain**

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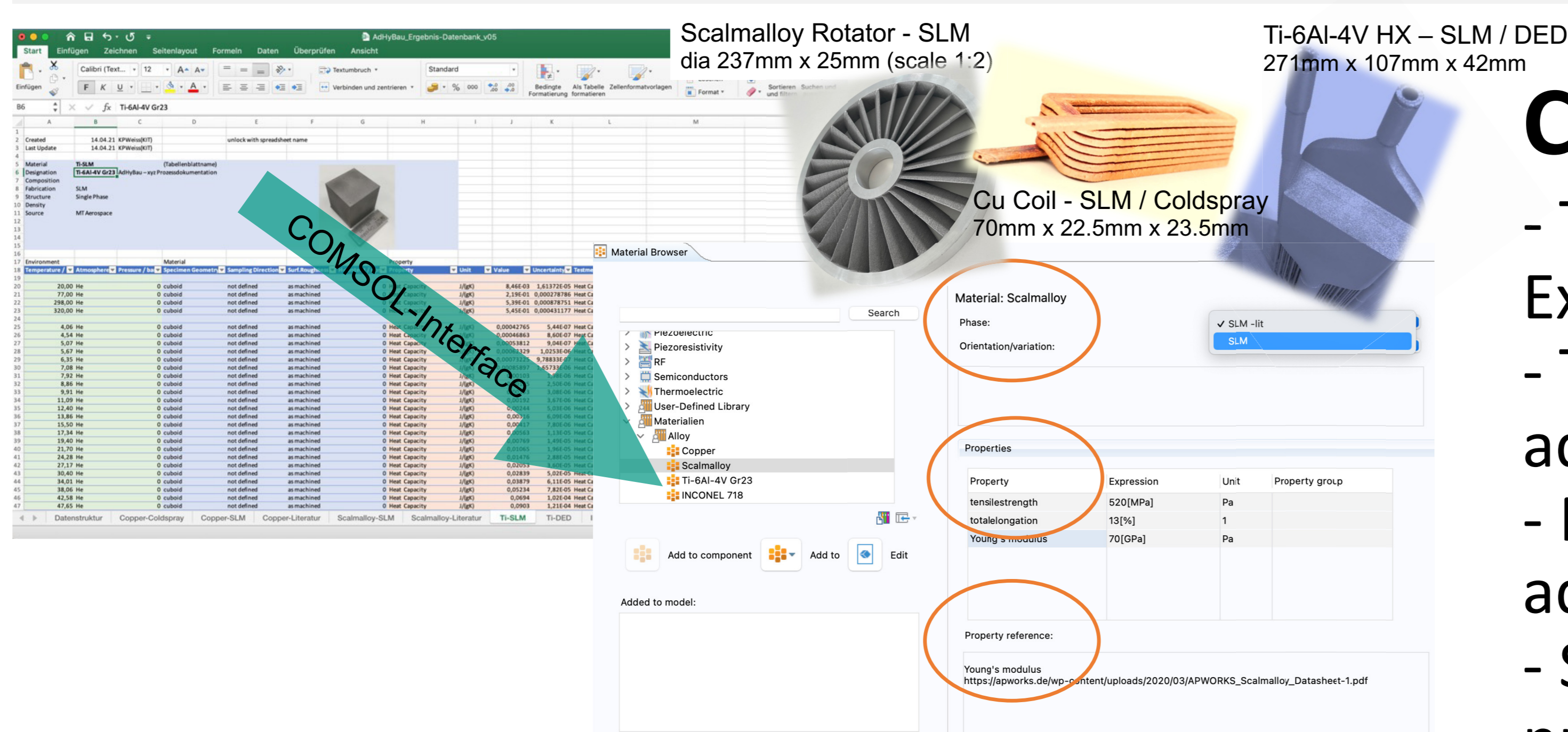
## Introduction

Goal of the project is to create end-to-end design and simulation processes to represent reality as accurately as possible in a digital twin.

To combine the simulation of the electric hydrogen propulsion system with real data, the material properties are compiled in a database file.

To incorporate the data into finite element method (FEM) software such as COMSOL®, a Python® script was created to read the data and, if necessary, convert the information into a file readable by the FEM software as a three-dimensional tensor.

Material ontologies will be used in the next steps.



## COMSOL Material Interface

- The material properties are collected in a repository (e.g. Excel®) to be used for later processing.
- The used syntax is checked via a lexicon (separate adjustable file) for COMSOL integration of the properties.
- Phase/Orientation, Variation, Properties, Sources are addressed and implemented in the general material library
- Selection according to the desired additive manufacturing process (CS, SLM, DED).

Excel data files converted by python-script (COMSOL-Interface) to mph file, direct import in the Material Browser

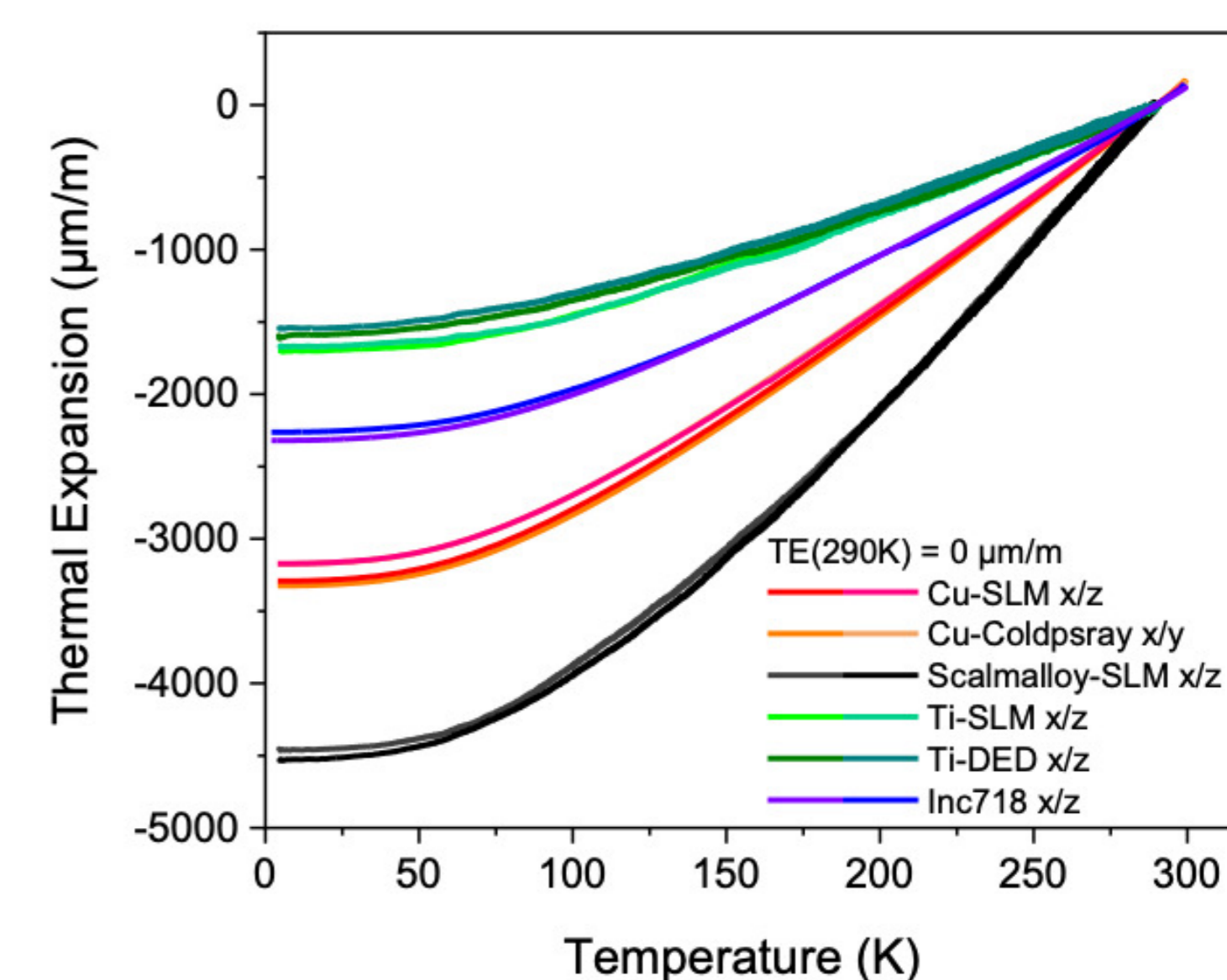
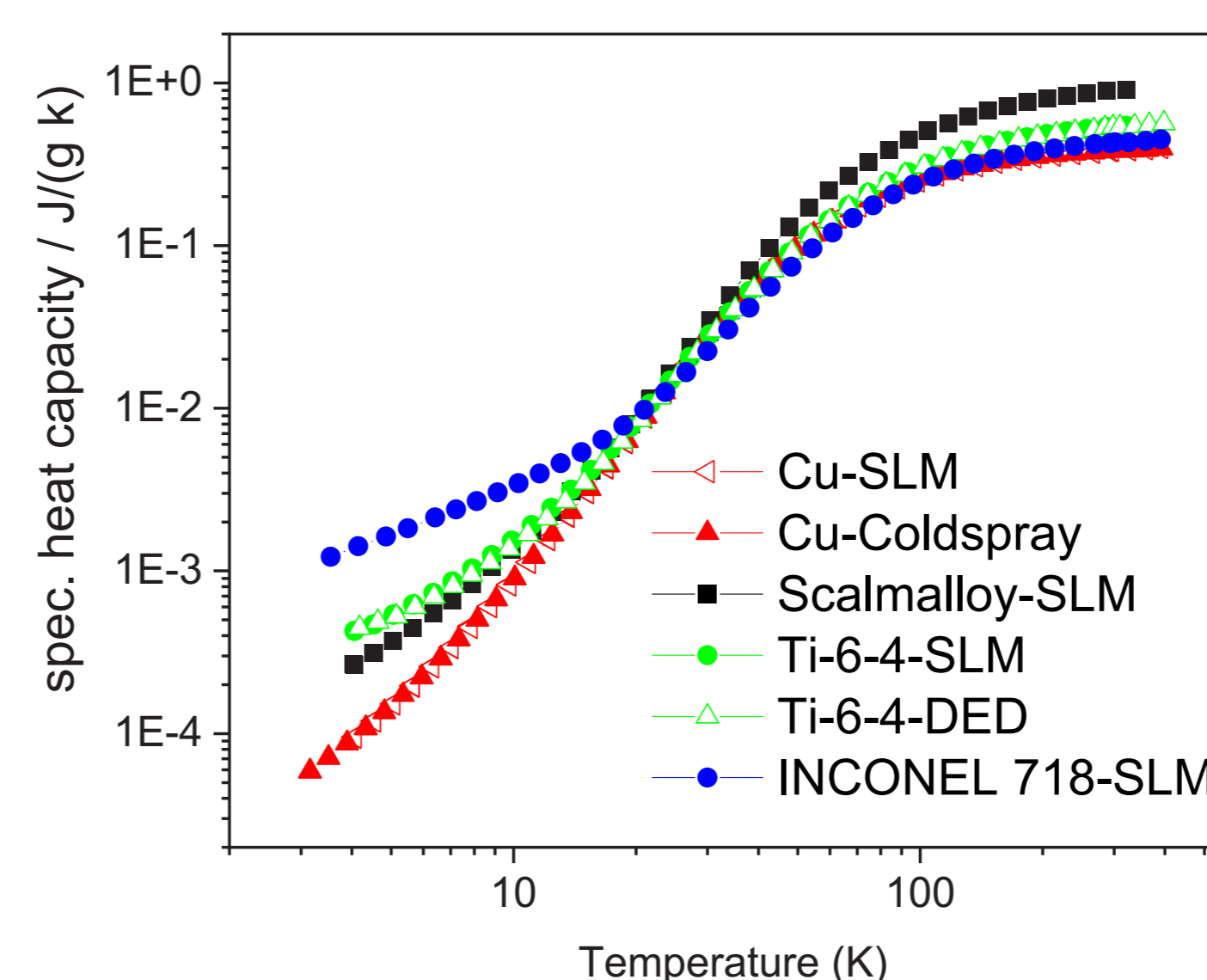
This allows direct physical coupling in the component simulations in terms of mechanical or thermal behavior.

## Material Properties

Material investigations carried out at KIT [1] together with the Fraunhofer Institute for Materials Engineering [2]. Providing mechanical and thermo-physical data:

tensile, fatigue, therm./elec. conductivity, heat capacity, thermal expansion, ...

Using the material data, the design, simulation and construction of the components is done by Siemens AG [3], Institute for Lightweight Construction at TU Dresden [4] and by MT-Aerospace AG [5].



Measurement data obtained in cryogenic temperature regime down to 4.2K (KIT-CryoMaK [1])

## REFERENCES

- [1] K-P Weiss et al, IOP Conf. Ser.: Mater. Sci. Eng. 1241 012047, 2022
- [2] F Ebling et al, Proceedings of the Fourth International Conference on Metals & Hydrogen, B02, ISBN 9789081794237, 2022
- [3] M Filipenko et al, Supercond Sci Technol 33(5) 054002, 2020
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- [5] M Vietze et al, International Journal of Hydrogen Energy 47 38793e38810, 2022



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