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Projekttitel: Tungsten Multi-Filament-Yarns for W_f/W-Composite Materials for Future High-Temperature & High-Power Energy Systems – TuMmY

Partner: Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research, IEK-4: Plasma Physics (IEK-4)

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Mission Statement

Operational temperature of metallic materials even of specialized nickel based super-alloys is limited to temperatures below a maximum of 980 °C and ceramic materials are limited due to their low impact resistance and micro cracking. A possible solution for high temperature (HT) and high power energy technologies is tungsten (W), having the highest melting point of all pure metal materials (3763 K). An inherent problem of tungsten is the intrinsic brittleness at room temperature, which makes it prone to low-cycle fatigue and to operational embrittlement under cyclic thermal loading. A possible solution to overcome this brittleness is the utilizing of extrinsic toughening mechanisms by including tungsten fibres into the bulk material and to form tungsten fibre-reinforced tungsten composites (W_f/W). To achieve the necessary high strength and a large boundary surface between fibre and matrix, wires with low diameters (below 20 µm) will be used in this project.

Primary objective of the intended collaboration between ITA and IEK-4 is to utilise the potential of W_f/W and establish the material for improved future high temperature and high power energy systems. **Aim of this seed-fund-project** is to proof, that filament-like wires can be processed and the mechanical performance of W_f/W can thus be significantly increased.

Therefore the possibility to manufacture multi-filament tungsten yarns and process them to W_f/W via chemical vapor deposition (CVD) will be studied.

In order to investigate the complex relation between the yarn structure, textile processability and the infiltration behaviour, different technical yarn structures consisting of tungsten filaments are designed, produced and tested. Subsequently the yarns are infiltrated with W in a CVD process and the infiltration behaviour is examined. Simultaneously the processability is evaluated in a weaving process. Furthermore the fundamental impact of tungsten filaments on the composite will be studied by mechanical testing of the yarns, textiles and, ultimately, the composite.

By end of the project the results are published and used to apply for follow-up funding in order to establish W_f/W as a unique HT-material.

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Kontakt

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