Karlsruher Institut für Technologie

Cryogenic Material Tests Karlsruhe
CryoMaK – an overview

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Cryogenic material laboratory within ITEP

- Necessity to characterize materials at operational temperatures
  → RT – 4.2 K

  - Mechanical properties (tensile, fracture, fatigue…)
  - Electro-mechanical investigations
  - Thermal conductivity / expansion, heat capacity, magnetization
  - Inhouse development and production of appropriate sensors
  - Additional investigations like surface roughness, optical, SEM/EDX/EBSD, HV, outgassing

- Advantage of combination of test methods in one laboratory with expertise of about 30 years

Cryogenic Materialtests Karlsruhe
CryoMaK

Cryogenic material laboratory within ITEP

- Necessity to characterize materials at operational temperatures
  → RT – 4.2 K

  - Steel materials (316/316L or 304/304L; Inconel Ni-Cr base; Nitronic 50 or similar; Mo-based alloys e.g. Haynes242; Ti/Mg/Al/Cu-alloys …)
  - Composite materials (glas, carbon …)
  - Different production routes (casting; cold deformation; additive manufacturing; prepreg/pultruded …)
  - Small size specimen up to component testing

Testfacility CryoMaK

- Mechanical investigation

ATLAS axial ± 650 kN
„Full-Size" components

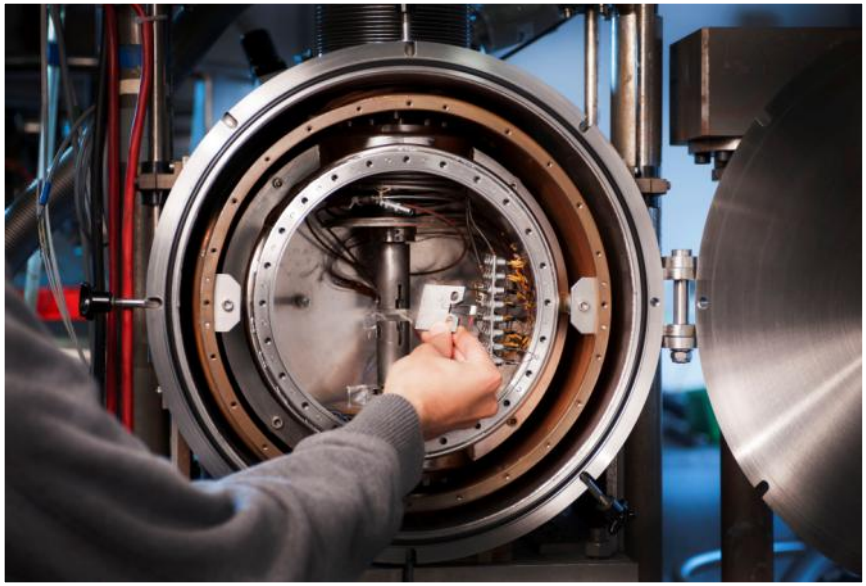
PHOENIX
axial ±100 kN

Testfacility CryoMaK

- Mechanical investigation

TORSION axial ± 100 kN
torsion ± 1000 Nm

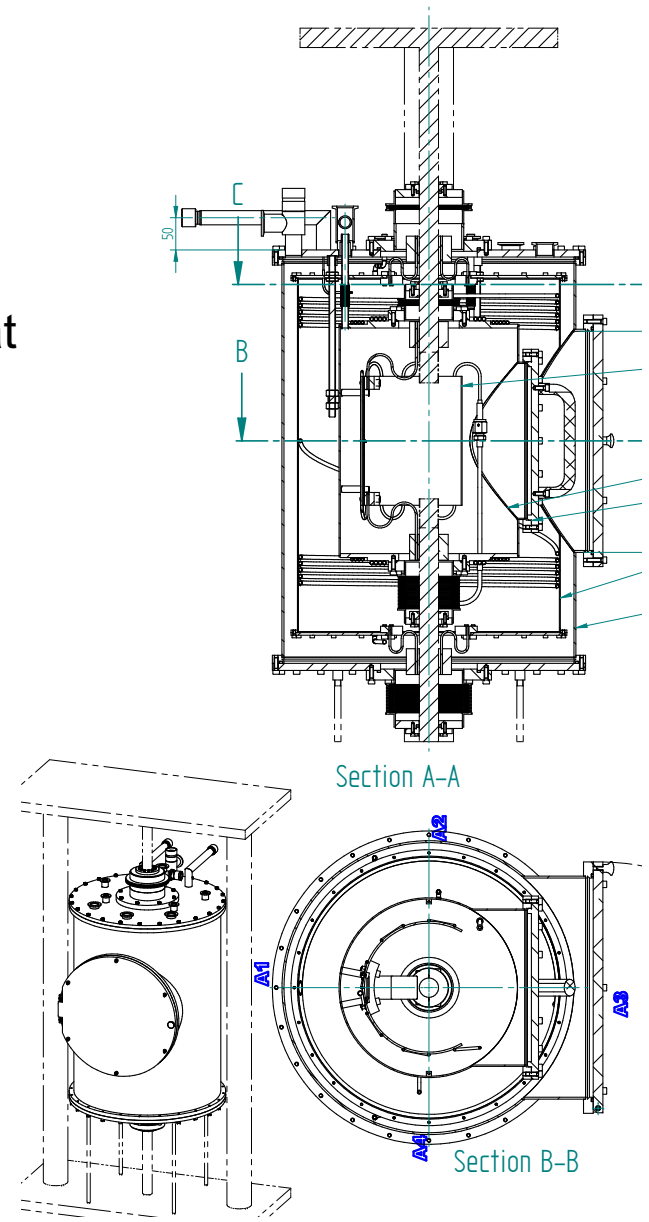
MTS25 & 50
axial ± 25 kN und ± 50 kN



Testfacility CryoMaK

- Mechanical investigation

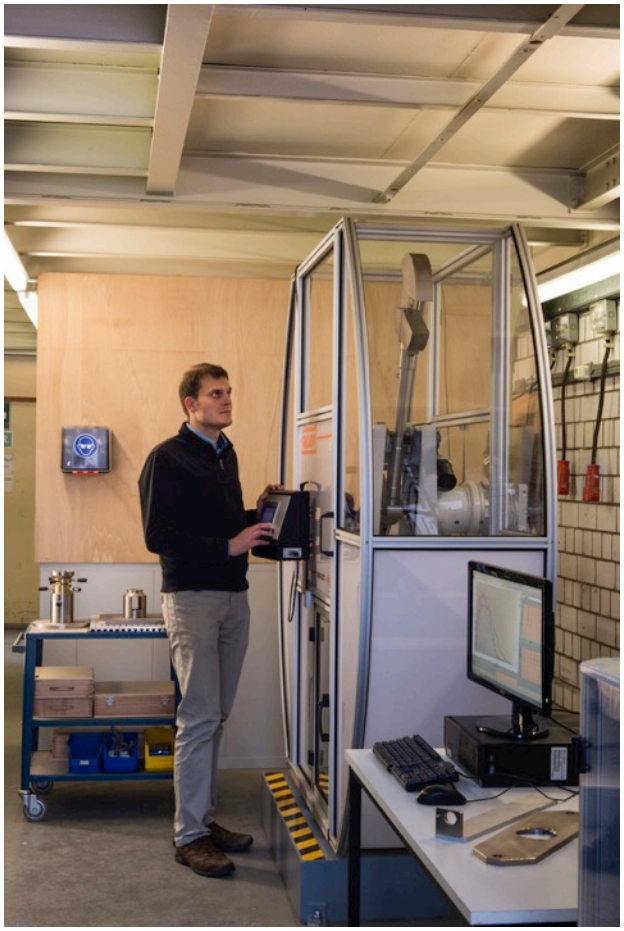
MTS100 to be equipped with cryostat



Testfacility CryoMaK

- Impact test

Charpy 450J



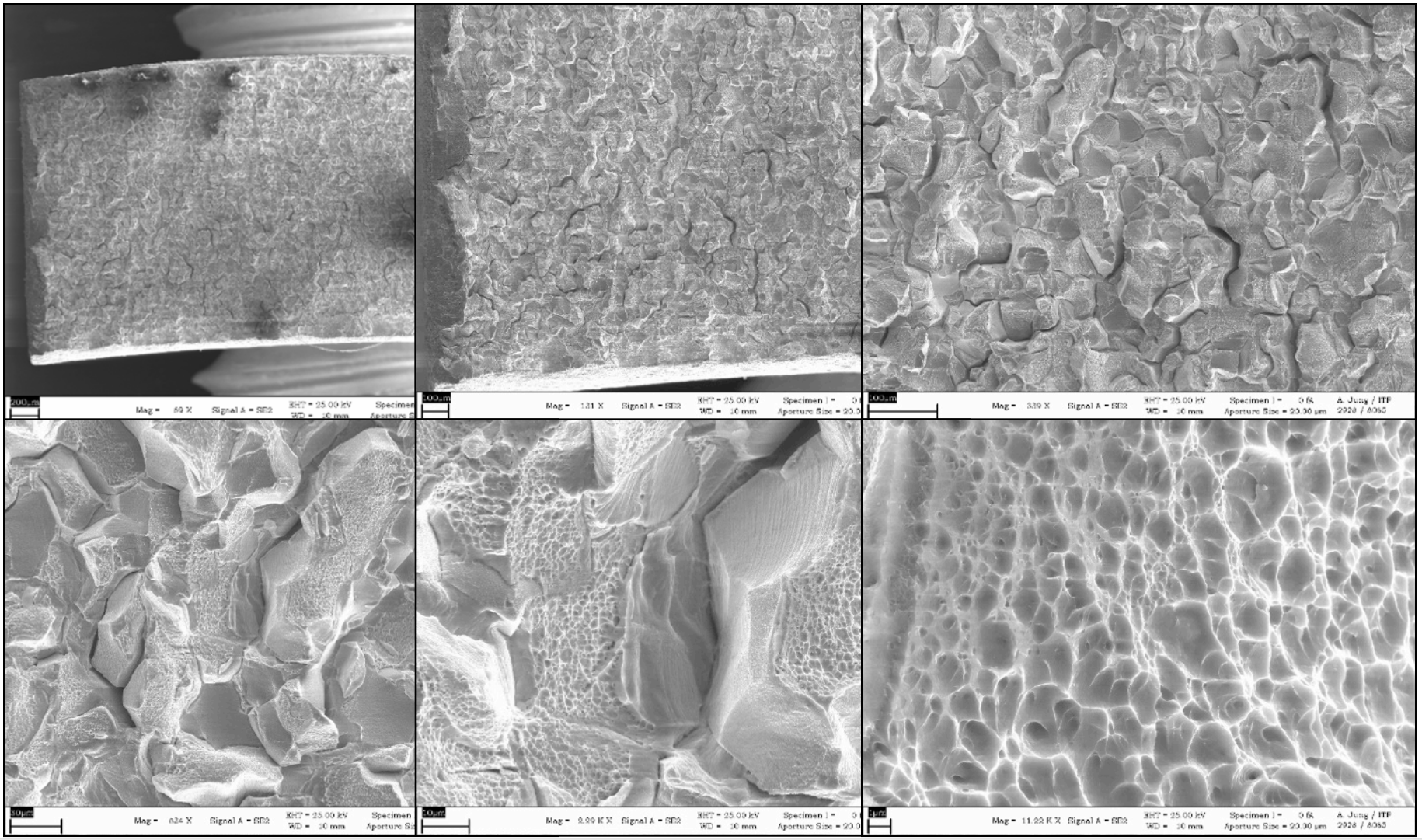
Drop weight tower

Testfacility CryoMaK

- Bruker Spectrometer Chemical composition of metals
- Optical assessment
- Vickers Hardnesstest

ITER – TF jacket

SEM of specimen max. elongation < 20%



Testfacility CryoMaK

Poisson-ratio assembly

High-precision Extensometer

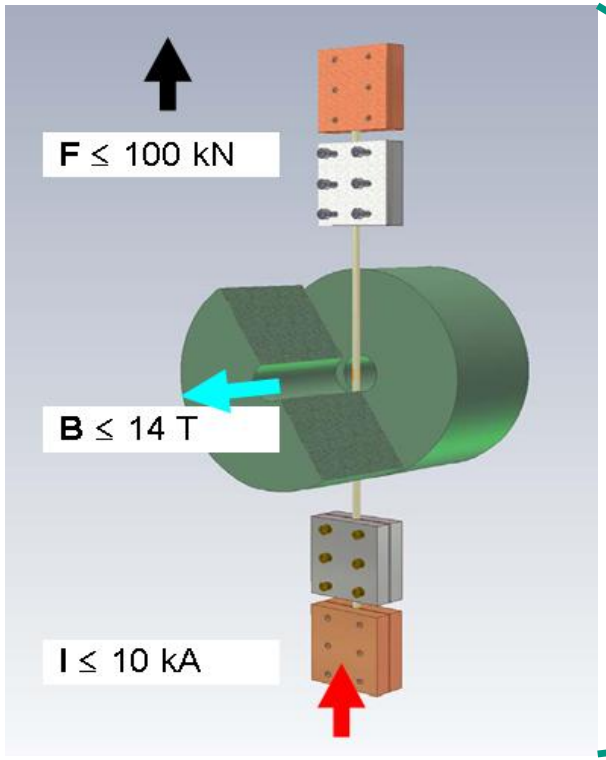
10-fold specimen rig

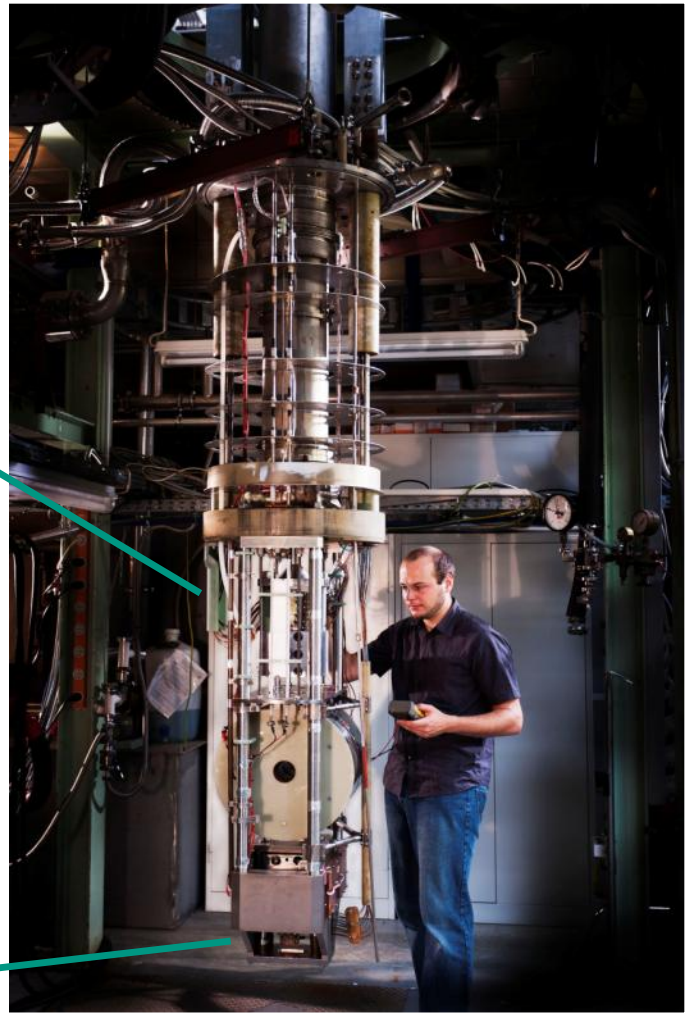
high-sensitive load cell

Testfacility CryoMaK – FBI facility

- Electro-Mechanical investigations of superonductors in magnetic field

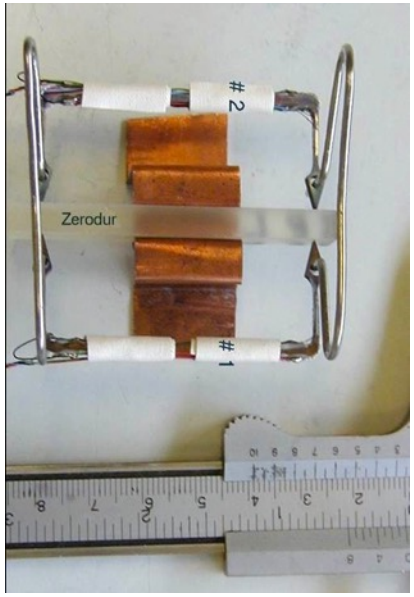
FBI
4.2 K to 77 K



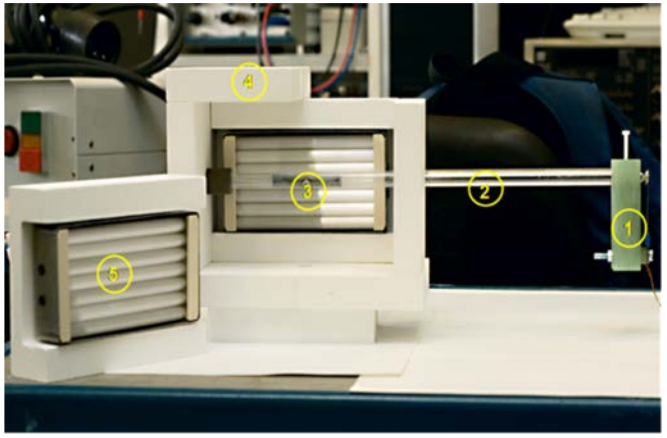


Testfacility CryoMaK – Thermal Expansion

TE (4.2 – 290K)

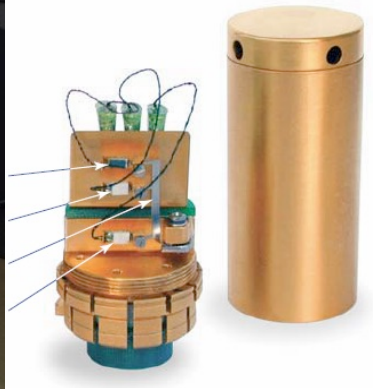


High-temperature TE measurement 300 K - 900 K



Testfacility CryoMaK – Thermal Conductivity

Physical Property Measurement System (9T and 14T)
Heat capacity, thermal conductivity, electrical conductivity, magnetization

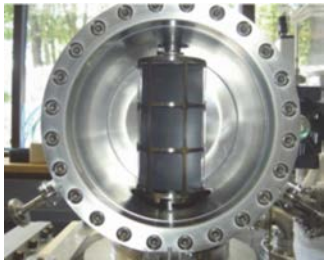


Further Characterization at ITEP

- SEM - Leo1530 (Zeiss) with EDX-System Noran SystemSix (Thermo Scientific) and EBSD-System Nordlys II (Oxford Instruments)

- XRD- D8-Discover(Bruker)

- High Voltage Lab for small specimen up to components at RT or cryogenic temperatures



- Outgassing rate measurements of stainless steel and polymer