Karlsruhe Institute of Technology

HELMHOLTZ ASSOCIATION

LIMTECH Alliance *and HEMCP:*
*Helmholtz Energy Materials Characterization Platform*

# B4: Phase changes in liquid metals for direct energy conversion

## Alkali Metal Thermal to Electric Converter (AMTEC)

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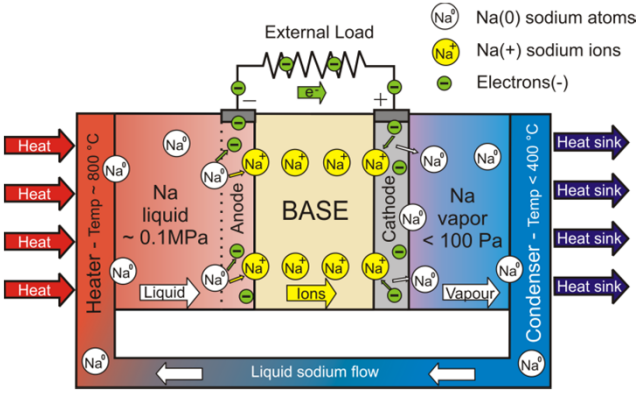
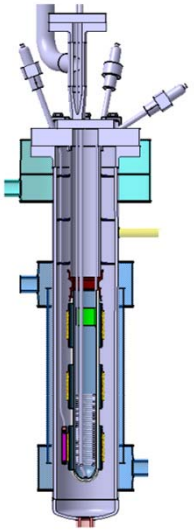
Karlsruhe Institute of Technology (KIT) – Institute for Neutron Physics and Reactor Technology (INR)



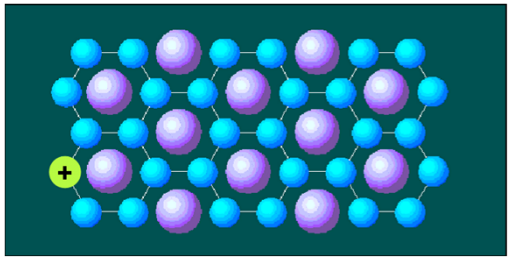



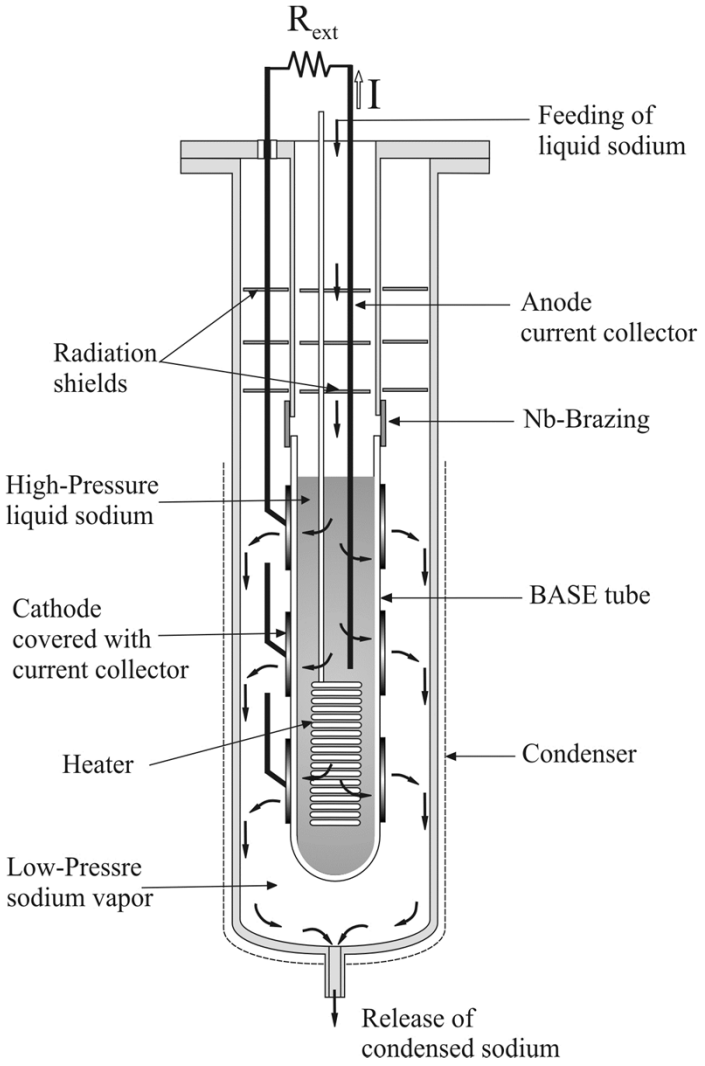
# Introduction

## Alkali Metal Thermal to Electric Converter

- Key component:
  β''-Alumina Solid Electrolyte (BASE)
- Key process: Na-ionization
  ΔP across BASE → Δ(sodium activity)

$$Na \rightarrow Na^{+} + e^{-}$$



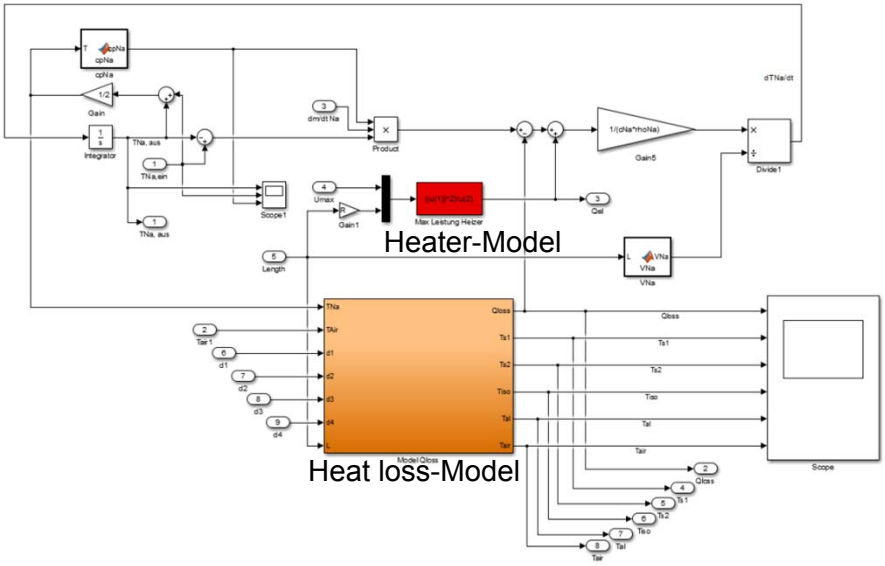




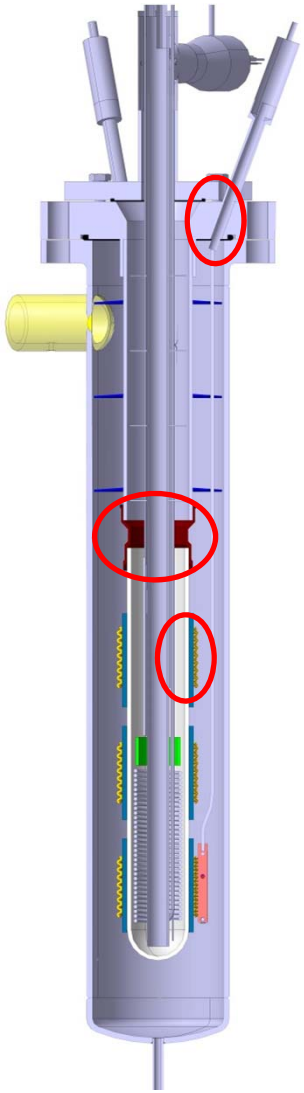

Institute for Neutron Physics and Reactor Technology
Safety of Nuclear Facilities

# Status AMTEC Test FAcility (ATEFA)

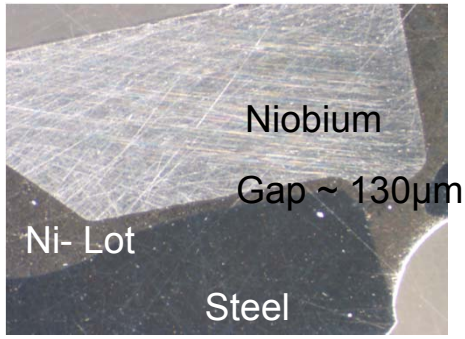
- ✓ Final assembly phase
- ✓ First Na-transport cask finished (TC, heating trace and thermal isolation)
- ✓ Instrumentation and armature tested
- ✓ Cooling system of AMTEC cell and AMTEC laboratory designed
- ✓ Data acquisition and controll system tested
- ✓ Software in Matlab-Simulink for simulation of temperature control in trace heating developed




# Evaluation test for material and process selection



- ✓ Nb – steel joining tests

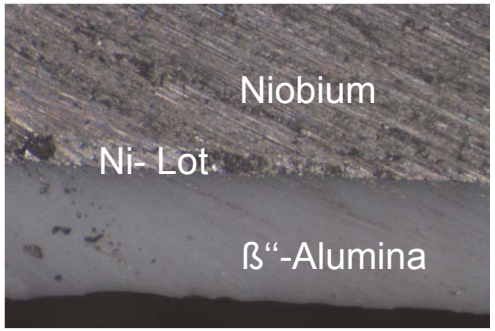



- ✓ Electrode sputtering tests extended to further materials

Molybdenum

TiN (different compositions)

- ✓ ß“-Alumina – Nb joining tests




- ✓ Sealing tests for TC feedthrough (200 °C, high tightness)

- ✓ Scoping test of PEEK chemical stability in Na

PEEK sample (~ 1 cm²) tested at 200 °C in liquid Na after 5, 15, 30 minutes and 1 hour*

*N. Diez de los Rios et al., Proceedings IYCE2015

# Summary and outlook

- Project in an advance phase
- Preliminary tests for AMTEC test cell finished
- Cell assembly finishes in July
- ATEFA final assembly phase (next: trace heating, AMTEC cell connection)
- Software for control system of ATEFA started
- Set into operation of ATEFA in autumn 2015
- First measurement campaign end of 2015