



2025 Helmholtz – OCPC – Program for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Elastocaloric cooling based on shape memory alloys

Helmholtz Centre and/or institute:

Karlsruhe Institute of Technology (KIT), Institute of Microstructure Technology (IMT)

Project leader:

Dr. Jingyuan Xu

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Description of the project (max. 1 page):

In Germany, refrigeration accounts for 14% of electricity consumption. This proportion is expected to increase steadily in the future. Innovations in cooling technology can therefore make an important contribution to climate and environmental protection.

Elastocaloric cooling is a new emerging solid-state cooling technology with the potential to provide environmentally friendly cooling with high efficiency. Currently, superelastic shape memory alloys (SMA) are the most promising elastocaloric materials. They respond to the application and release of stress by self-heating and -cooling, respectively, due to a reversible solid-to-solid phase transformation. SMA films are especially promising for elastocaloric cooling, since they combine a high elastocaloric effect size with highly efficient heat transfer due to the large surface-to-volume ratio of film geometries. In previous work, first SMA film-based elastocaloric cooling demonstrators have been fabricated and tested successfully. The present work intends to extend the demonstrator concept to cascaded and parallel designs to enhance the temperature range and cooling power.

The goal of the postdoc candidate will be to prepare the elastocaloric cooling device with excellent elastocaloric properties using SMAs. Candidates will pay particular attention to the experimental material characterization properties. Prototype of the high-performance elastocaloric cooling devices based on SMAs are expected to be developed.

The candidate will be fully supported by our team and will benefit from the expertise of the group especially regarding material characterization technologies including tensile test, infrared thermography and differential scanning calorimetry, as well as prototype development. He/She will have access to state-of-the-art equipment at IMT including 600 m² clean room, rapid prototyping processes such as 3D printing and laser cutting, assembly and joining technology laboratories, various metrological laboratories.

The results of the candidate will allow a better understanding of the elastocaloric effects in SMAs and use them to develop cooling devices for cooling or heat pumping applications.

Description of existing or sought Chinese collaboration partner institute (max. half page):

N/A

Required qualification of the postdoc:

- PhD in mechanical engineering, electrical engineering or physics
- Experience with thermodynamics, heat transfer, materials science of shape memory alloys
- Additional skills in mechanical design and micro technologies
- Language requirement: Fluent in English