Business plan for a DIN SPEC project according to the PAS procedure on "Magnetocalorics – Measurement of magnetocaloric properties of magnetocaloric materials"

Status:
Public Commenting

Requests to participate in the project and/or comments on the business plan are to be submitted by 13th of September 2018 to spec@din.de[1]

Recipients of this business plan are requested to name all patent rights known to them to be relevant to the project and to make available all supporting documents.

Berlin, 16th of August 2018

[1] Applications for participating in the project and comments on the business plan that are not received by the deadline do not need to be taken into consideration. Once constituted, the project workshop will decide whether or not to consider the comments received in good time.

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1. Status of the business plan

- **For public commenting (publication)**

This business plan is intended to inform the public of a new DIN SPEC project. Any interested party can take part in this project and/or comment on this business plan. Please send any requests to participate or comments by e-mail to spec@din.de.

Once this business plan is published, the Chairman of DIN's Executive Board decides whether or not the project is to be carried out.

If the project is accepted, all those who have applied for participation or have commented on the business plan by the deadline will be invited to the kick-off meeting of the project workshop.

2. Initiator and other workshop members

- Initiator:

Person/Organization	Short description
Oliver Gutfleisch TU Darmstadt Functional Materials	Prof. Oliver Gutfleisch is a full Professor (W3) for Functional Materials at TU Darmstadt and a scientific manager at Fraunhofer IWKS Materials Recycling and Resource Strategies. He studied Material Science at TU Berlin, did his Phd in Birmingham, UK, and was a group leader at Leibniz Institute IFW Dresden. 2012 he joined TU Darmstadt. His scientific interests span from new permanent magnets for power applications to solid state energy efficient magnetic cooling, ferromagnetic shape memory alloys, magnetic nanoparticles for biomedical applications, and to solid state hydrogen storage materials with a particular emphasis on tailoring structural and chemical properties on the nanoscale. Resource efficiency on element, process and product levels as well as recycling of rare earth containing materials are also in the focus of his work.

Other potential participants:

- Manufacturer of magnetocaloric materials
- Scientists
- Manufacturer of refrigerators
- Manufacturer of measuring instruments for the determination of the properties of magnetocaloric materials
- PTB - The National Metrology Institute of Germany
- Companies interested in the application of magnetocaloric materials
- ZIM Netzwerk Magnetocalorics

This DIN SPEC will be developed in a workshop (temporary body) that is open to any interested party. The participation of other experts would be helpful and is desired. It is recommended that participants of these areas take part in the development of this DIN SPEC.

- Participants at the kick-off meeting:

Person	**Organization**
Oliver Gutfleisch	TU Darmstadt
Alexander Barcza	Vacuumschmelze GmbH & Co KG
Irene Dumkow	BSH Hausgeräte
Amelie Leipprand	DIN

- Participants who have approved this business plan (workshop members).

Person	**Organization**

3. Objectives of the project

3.1. General

Magnetic cooling is based on the magnetocaloric effect (MCE), which manifests itself in a temperature change of a magnetocaloric material (MCM) when a magnetic field is applied. The mode of operation of a magnetic cooling circuit is based on the cyclic application of the MCE. Figure 1 (see attachment) shows the scheme of such a cooling cycle, which is also referred to as a Brayton magnetic. In the initial state (a), the magnetic moments are randomly oriented as a result of the thermal fluctuation. This is called a paramagnetic state. If the material is adiabatically magnetized (b), the magnetic moments are aligned along the external magnetic field lines, increasing the temperature of the material (to compensate for the lowered magnetic entropy by increasing thermal entropy). By removing the excess heat with the applied magnetic field (c), the material is cooled to its starting temperature. The subsequent adiabatic demagnetization (d) is associated with a lowering of the temperature, whereby the material is able to remove its ambient heat. If the cycle is isothermic, there is a decrease in the magnetic entropy when the magnetic field strength is increased. According to the second principle of thermodynamics, the entropy decrease is associated with a heat dissipation of the material. On the other hand, the MCM absorbs heat from its surroundings when the magnetic field is switched off.

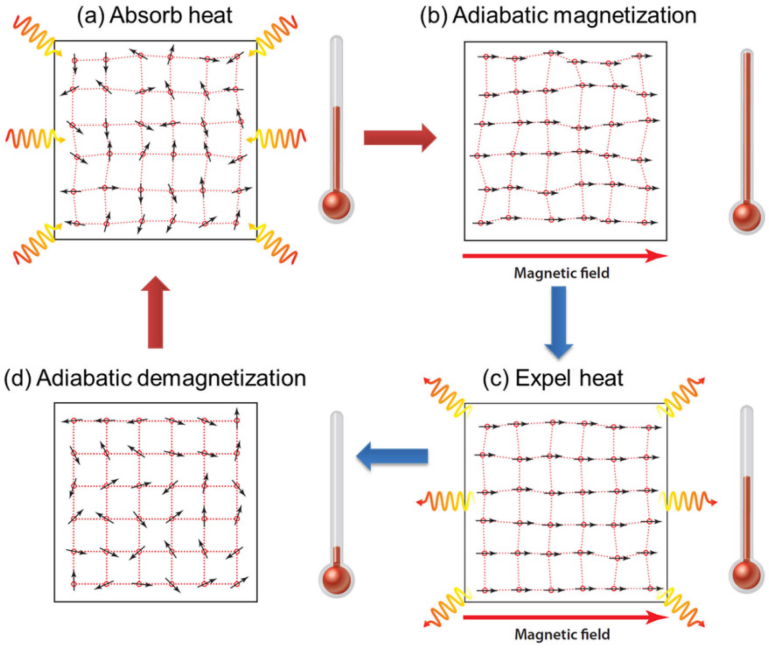

Figure 1: Schematic of the magnetic cooling cycle

The advancement of magnetocaloric cooling to an applicable product would benefit the German economy in a variety of ways and provide a building block for the energy transition. The introduction of standards for the terminology and the measurement of the relevant magnetocaloric parameters represents an important step in this direction.

The potential user circle of standardization comprises, on the one hand, material manufacturers, such as BASF SE or Vacuumschmelze GmbH & Co KG, both investing in magnetocalorics and marketing materials commercially. These entrepreneurs would benefit from a standard because it can serve as an independent quality seal for their material.

Another industry includes the manufacturers of cooling machines. These include, for example, companies such as Liebherr-International Deutschland GmbH, Electrolux Hausgeräte GmbH, Miele & Cie. KG, BSH Hausgeräte GmbH and Linde AG. These companies are extremely interested in magnetocaloric cooling and are represented at relevant conferences.

In this field of engineering, small start-up companies have the potential to enter the market, as Cooltech Applications has already achieved in France. This fact also emphasizes the urgency and the success potential for the technology, which has already been implemented abroad. Particularly in niche applications, such as cooling in medical technology during the transport of transplantation organs, there are requirements that small companies will occupy using magnetocaloric cooling.

Additionally, research institutes and development departments of small companies can benefit from a standardized terminology and a measurement standard. They can reliably use the acquired measurement data in simulations and optimizations and can rely on the measured values through the standard. This can enable groups which are not experts in the field of magnetocalorics to develop this technology further and create new synergies.

3.2. Planned scope

This DIN SPEC will provide unified rules for the measurement of the most important magnetocaloric properties of magnetocaloric materials, ΔS_T and ΔT_{ad}.

4. Work programme

4.1. General

The aim of the project is to develop a DIN SPEC according to the PAS procedure (“DIN SPEC (PAS)”) (see www.din.de/go/din-spec-en). The DIN SPEC shall be consistent with the body of German standards and shall not contradict any DIN Standard.

The planned starting date is 20th of September 2018 (kick-off meeting). The project duration will be about nine months.

The DIN SPEC will be drawn up in English (language of meetings, minutes, etc.). The DIN SPEC will be prepared and published in English.

NOTE The calculation covers only one language version. Please keep in mind the fact that other language versions involve additional expenses; for this reason, they shall be agreed on separately. If another language version is desired, Beuth Verlag/DIN can provide a translation. Requests for translations are to be submitted after the DIN SPEC manuscript has been adopted for publication.

4.2 Work plan

The kick-off meeting is planned to take place on 20th of September 2018 in Darmstadt.

At this meeting, the workshop for developing the DIN SPEC will be constituted, and further organizational issues and the subject of the work will be agreed on.

Two additional project meetings will also be held and one web conference is planned, during which the content of the DIN SPEC will be presented, discussed and adopted. The content of the DIN SPEC can also be drawn up by individual workshop members or in working groups.

Dates of further meetings and/or web conferences are to be agreed on within the workshop in consultation with DIN.

5. Organization of the workshop (temporary body)

This project is governed by the rules of procedure for developing DIN SPEC PAS. All interested parties and workshop members are to inform themselves of these procedures by going to www.din.de/go/din-spec-en.

The workshop will be constituted during the course of the kick-off meeting. The kick-off meeting will not take place until the business plan has been published and approved by DIN's Executive Board. The workshop shall comprise at least three members from different organizations. It is not necessary that these members come from different areas and represent different stakeholders. By approving this business plan, the interested parties declare their willingness to participate in the workshop and will be formally named as workshop members, with the associated rights and duties. Participants at the kick-off meeting who do not approve the business plan are not given the status of a workshop member and are thus excluded from further decisions made during the kick-off meeting and from any other decisions regarding the project.

If an organization (e.g. an association) sends someone who is not an employee to the workshop, this person shall be authorized by the organization, who shall provide proof of this to DIN.

Each workshop member is entitled to vote and has one vote. If an organization sends several experts to the workshop, that organization has only one vote, regardless of how many workshop participants it sends. Transferring voting rights to other workshop members is not permitted. During voting procedures, decisions are passed by simple majority, not counting abstentions.

As a rule, the workshop is closed once it is constituted. The current workshop members shall decide whether any additional members will be accepted or not.

During the kick-off meeting, the workshop members shall elect a workshop leader, who is responsible for content management and any decision-making and voting procedures. The leader is supported by the responsible DIN Project Manager, whereby DIN will always remain neutral regarding the content of the DIN SPEC. Furthermore, the DIN Project Manager shall ensure that DIN's rules of procedure, rules of presentation, and the principles governing the publication of DIN SPEC have been observed Should a workshop leader no longer be able to carry out his/her duties, the DIN Project Manager shall initiate the election of a new leader. The core task of the workshop leader is content management.

The DIN Project Manager is responsible for organizing and leading the kick-off meeting, in consultation with the initiator. Further project meetings and/or web conferences shall be organized by the DIN Project Manager in consultation with the workshop leader.

If workshop members cannot be present when the DIN SPEC or its draft is adopted, an alternative means of including them in the voting procedure shall be used (e.g. in writing, electronically).

All workshop members who voted for the publication of the DIN SPEC or its draft will be named as authors in the Foreword, including the organizations which they represent. All workshop members who voted against the publication of the DIN SPEC or its draft, or who have abstained, may not be named in the Foreword.

To allow the legal reproduction and distribution of results for the purposes of project work, the workshop members grant DIN rights of use on the basis of the copyright that will accrue to them for the results of their work on the DIN SPEC. The transfer of these utilization rights does not prevent the workshop members from using and further developing the knowledge, experience and findings they bring to the project.

Workshop members are requested to inform DIN of all patent rights known to them to be relevant to this DIN SPEC project.

Subsequent changes to this business plan require a two-thirds majority of all workshop members, as well as the approval of DIN.

6. Resource planning

Each workshop member shall bear the costs of participation in the project.

If the Chairman of DIN's Executive Board approves the project the workshop will be constituted during the course of the kick-off meeting.

Workshop membership and participation in the project meetings is free of charge, as the costs incurred to DIN throughout the performance of this project will be financed by funding from the DIN-Connect project "Calorinorm".

7. Related activities

The subject of the planned DIN SPEC is not at present the subject of a standard. However, there are bodies, standards and/or other technical rules that deal with related subjects and thus need to be taken into account - and involved or incorporated, where necessary - during this project:

- DIN Standards Committee Refrigeration Technology (FNKä)
- DIN Standards Committee technical fundamentals (NATG)
- DIN Standards Committee Terminology (NAT)
- DIN Standards Committee Materials Testing (NMP)
- DIN 1345:1993-12 Thermodynamics; terminology
- DIN EN 50483-5 Test requirements for low voltage aerial bundled cable accessories - Part 5: Electrical ageing test

8. Contacts

- Workshop leader:

  to be determined

- Project Manager
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Annex: Project schedule (preliminary)

	2018												2019															
	Jul		Aug		Sep		Oct		Nov		Dez		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug	
Initiierung																												
1. Publication of business plan																												
Workshop-phase																												
4. Kick-off meeting / workshop constituted																												
5. DIN SPEC (PAS) drawn up																												
6. DIN SPEC (PAS) adopted by Workshop																												
Publication																												
11. Review and release by DIN																												
12. Publication of DIN SPEC (PAS)																												
Milestones						**K**				**W**				**W**				**W**						**A**				

K→Kick-Off; **M** →Project meeting; **W**→ Web conference; **A**→ Adoption of DIN SPEC (PAS)