

**MH 2300 Functional materials 6 hp****Course PM*****Aim***

To gain deep knowledge about materials which are not primarily used for their mechanical properties, but for other properties such as physical. To know what "functions" can be built into the materials and how to maximise their performance.

***Syllabus***

Specific properties of functional materials are covered, which are used in high-tech applications. The course includes:

- Intermetallic materials
- Shape memory alloys
- Applications of advanced ceramics
- Magnetic materials
- Conducting thermoplastics
- Semiconductors

***Language***

The course is given in English.

***Teachers***

Lectures and seminars: Pavel Korzhavyi, [pavelk@kth.se](mailto:pavelk@kth.se), tel. 790 9193

Projects and guest lecture: Claudio Lousada, [cmlp@kth.se](mailto:cmlp@kth.se), tel. 790 8789

***Lectures (different rooms at Brinellvägen 23)***

Date	Part	Room	Theme
Monday March 18, 15-17	I	M121(Blå)	Intermetallic materials I
Wednesday March 20, 13-15	I	M121(Blå)	Intermetallic materials II
Monday March 25, 15-17	I	M121(Blå)	Advanced ceramics: Ferroelectrics I
Wednesday March 27, 13-15	I	M121(Blå)	Advanced ceramics: Ferroelectrics II
Wednesday April 3, 13-15	II	M121(Blå)	Magnetic materials
Monday April 8, 15-17	II	M121(Blå)	Shape memory alloys
Wednesday April 10, 13-15	II	M121(Blå)	Catalytic materials
Tuesday April 23, 15-17	II	M121(Blå)	Semiconductors I
Wednesday April 24, 13-15	II	M121(Blå)	Semiconductors II
Monday May 6, 15-17		M121(Blå)	Partial reporting of projects
Monday May 13, 15-17		M121(Blå)	Reporting of projects

**Tests (kontrollskrivningar)****On lectures part I: Monday April 1, 08:00-10:00, M121(Blå)****On lectures part II: Monday April 29, 08:00-10:00, M121(Blå)****Examination**

For all students:

- i) written report to be presented at the seminars (see special instruction)
- ii) participation in seminars
- iii) approved tests

Those who could not attend or pass tests I or II, may (re)write tests on the exam week,**Voluntarily examination: Wednesday May 29, 08:00-12:00, M121(Blå).****Course literature**

Compendium on Functional materials (excl. chapters 4 to 6 on biomaterials)

Distributed articles

Results of a literature search should be used for the preparation of the report.

**Short layout of the reports to be written**

- Register for a report topic as soon as possible
- Use the listed literature review as a starting point. Use Elsevier's Science Direct to search for more literature.
- Summarise the scientific knowledge about the chosen topic. Always use your own words, do never copy text.
- Summarise the potential industrial applications for materials or techniques covers. Describe how knowledge could be commercialised.
- When you use a specific source you should always give a reference at that point.
- The report should be written as educational material at your own level. Thus the material should be suitable for a forthcoming course. Figures should be placed in the text, each with a caption below it. Each table, also in the text should have a heading above it.
- The expected size of each report is 10 A4 pages per student with 1.5 p line spacing, Times New Roman, 12 p (~10 A4 pages per student)
- Follow the guidelines<sup>1</sup> for how to write scientific reports.

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<sup>1</sup> Writing scientific reports, R. Sandström, D. Andersson (MS&E, KTH, 2008).

**Schedule**

Each group should present an **outline of the report** at the lecture on **Monday, May 6, 15:00-18:00, M121(Blå)**.

**The final reports** should be delivered strictly according to the schedule below in electronic form by email.

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<b>Presentation date</b>	<b>Report ready by</b>	<b>Send to</b>
Monday May 13, 15-18, M121(Blå)	May 12, 15:00	<a href="mailto:cmlp@kth.se">cmlp@kth.se</a>

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***Topics for Reports and Seminars (15 mins presentations by the students)***

No	Theme	Name
1	Cuprous oxide (Cu <sub>2</sub> O) crystals with tailored architectures: A comprehensive review on synthesis, fundamental properties, functional modifications and applications, <i>Progress in Materials Science</i> , Volume 96 (2018) Pages 111-173, Shaodong Sun, Xiaojing Zhang, Qing Yang, Shuhua Liang, Xiaozhe Zhang, Zhimao Yang	
2	Magnetocaloric effect: From materials research to refrigeration devices, <i>Progress in Materials Science</i> , Volume 93 (2018) Pages 112-232, V. Franco, J.S. Blázquez, J.J. Ipus, J.Y. Law, L.M. Moreno-Ramírez, A. Conde	
3	Chalcogenide glass-ceramics: Functional design and crystallization mechanism, <i>Progress in Materials Science</i> , Volume 93 (2018) Pages 1-44, Changgui Lin, Christian Rüssel, Shixun Dai	
4	Hybrid spintronic materials: Growth, structure and properties, <i>Progress in Materials Science</i> , Volume 99 (2019) Pages 27-105, Wenqing Liu, Ping Kwan Johnny Wong, Yongbing Xu	
5	Spintronics technology: past, present and future, <i>International Materials Reviews</i> , Volume 61, Issue 7 (2016) Pages 456-472, J. W. Lu, E. Chen, M. Kabir, M. R. Stan & S. A. Wolf	
6	Conductive nitrides: Growth principles, optical and electronic properties, and their perspectives in photonics and plasmonics, <i>Materials Science and Engineering R</i> , Volume 123 (2018) Pages 1-55, P. Patsalas, N. Kalfagiannis, S. Kassavetis, G. Abadias, D.V. Bellas, Ch. Lekka, E. Lidorikis	
7	Advances in tailoring the electronic properties of single-walled carbon nanotubes, <i>Progress in Materials Science</i> , Volume 77 (2016) Pages 125-211, M.V. Kharlamova	

Two or three students write a report on their topic (annotated, about 10 pages/student).

No	Theme	Name
8	Anisotropic magnetic nanoparticles: A review of their properties, syntheses and potential applications, <i>Progress in Materials Science</i> , Volume 95 (2018) Pages 286-328, Darja Lisjak, Alenka Mertelj	
9	Modern soft magnets: Amorphous and nano-crystalline materials, <i>Acta Materialia</i> , Volume 61, Issue 3 (2013) Pages 718-734, G. Herzer	
10	Nanomaterials as photothermal therapeutic agents, <i>Progress in Materials Science</i> , Volume 99 (2019) Pages 1-26, Junqi Chen, Chengyun Ning, Zhengnan Zhou, Peng Yu, Ye Zhu, Guoxin Tan, Chuanbin Mao	
11	Recent advances in wearable tactile sensors: Materials, sensing mechanisms, and device performance, <i>Materials Science and Engineering R</i> , Volume 115 (2017) Pages 1-37, Tingting Yang, Dan Xie, Zhihong Li, Hongwei Zhu	
12	Conductive polymers for thermoelectric power generation, <i>Progress in Materials Science</i> , Volume 93 (2018) Pages 270-310, Meetu Bharti, Ajay Singh, Soumen Samanta, D.K. Aswal	
13	Redox-electrolytes for non-flow electrochemical energy storage: A critical review and best practice, <i>Progress in Materials Science</i> , Volume 101 (2019) Pages 46-89, Juhan Lee, Pattarachai Srimuk, Simon Fleischmann, Xiao Su, T. Alan Hatton, Volker Presser	
14	Review on superior strength and enhanced ductility of metallic nanomaterials, <i>Progress in Materials Science</i> , Volume 94 (2018) Pages 462–540, I.A. Ovid'ko, R.Z. Valiev, Y.T. Zhu	
15	Progress in high-strain perovskite piezoelectric ceramics, <i>Materials Science &amp; Engineering R</i> , Volume 135 (2019) Pages 1-57, Jigong Hao, Wei Li, Jiwei Zhai, Haydn Chen	

Two or three students write a report on their topic (annotated, about 10 pages/student).

No	Theme	Name
16	Current trends, challenges, and perspectives of anti-fogging technology: Surface and material design, fabrication strategies, and beyond, <i>Progress in Materials Science</i> , Volume 99 (2019) Pages 106-186,	Iván Rodríguez Durán, Gaétan Laroche
17	Naturally-derived biopolymer nanocomposites: Interfacial design, properties and emerging applications, <i>Materials Science and Engineering R</i> , Volume 125 (2018) Pages 1-41, Rui Xiong, Anise M. Grant, Ruilong Ma, Shuaidi Zhang, Vladimir V. Tsukruk	
18	Recent advances in thermoelectric materials, <i>Progress in Materials Science</i> , Volume 83 (2016) Pages 330-382, Ch. Gayner, K.K. Kar	
19	Transparent heat regulating (THR) materials and coatings for energy saving window applications: Impact of materials design, micro-structural, and interface quality on the THR performance, <i>Progress in Materials Science</i> , Volume 95 (2018) Pages 42-131, Goutam Kumar Dalapati, Ajay Kumar Kushwaha, Mohit Sharma, Vignesh Suresh, Santiranjana Shannigrahi, Siarhei Zhuk, Saeid Masudy-Panah	
20	Recent developments of metallic nanoparticle-graphene nanocatalysts, <i>Progress in Materials Science</i> , Volume 94 (2018) Pages 306-383, Changlong Wang, Didier Astruc	
21	Electrically conducting fibres for e-textiles: An open playground for conjugated polymers and carbon nanomaterials, <i>Materials Science &amp; Engineering R</i> , Volume 126 (2018) Pages 1-29, Anja Lund, Natascha M. van der Velden, Nils-Krister Persson, Mahiar M. Hamed, Christian Müller	

Two or three students write a report on their topic (annotated, about 10 pages/student).