Magnetic Materials & Devices – Term Paper and Presentations

EE 396V (Unique ID 17820)/379K (Unique ID 17544) Spring 2021 (MW 3-4:30p Virtual)

1. Topic due by TBD

One paragraph describing the subject of the paper, citing at least two references. Can submit topic early. We will seek to have the topics distinct between students. E.g. if two students want to write on MRAM, will try to separate into e.g. one on current challenges with MRAM , the other on emerging technologies for MRAM.

2. 396V Only: Complete paper due on TBD

The term paper is a description of a class of magnetic materials or a magnetic device. This should be an in-depth discussion of the topic and field. The topic should be separate from what is discussed in class, or if you pick a topic from class the content must be significantly different/beyond what is discussed in class. See example topics below. The paper should be **minimum 5 pages** (12 point Times New Roman font, 1" margins, single-spaced) including reasonably-sized figures and captions but excluding references.

Some points to consider:

- Introduction and importance of the topic
- For a magnetic device, explain the operating principle of the device and what materials are used. For materials, explain the physics behind the magnetic behavior and the technological applications.
- Explain the history and seminal papers or breakthroughs regarding the device/material.
- Explain the promises and weaknesses/challenges of the device/materials for the desired applications.
- Explain where the field is going: what are the current barriers to improving the device or material properties? What new applications would be enabled by these improvements?
- Conclusions and summary.

Emphasis will be placed on the development of individual writing and literature review skills. Grading will be 70% content and 30% organization/clarity.

3. Both 396V and 379K: In-class virtual presentations

Each student will present slides and a ~10 minute talk on the term paper subject. **The slides must be submitted to the TA by the beginning of class for your presentation day** (please use PowerPoint). Treat as an educational talk to expose the class to the topic and summarize your paper. Will be graded on preparedness, clarity of visual/spoken content, and showing understanding of your subject.

Notes

- The topic must be clearly distinct from papers written for other classes. If you are unsure, please speak to the instructor or TA.
- You can either deeply discuss a particular device or material, or more broadly discuss devices/materials that fall under the chosen topic.
- The paper should be written at a level where someone taking this class can understand it.
- Copying *uncited* text/figures from other authors' work is unacceptable and will be given a zero grade. You are welcome to quote from others' work, but it must be in quotations with the source cited. Figures must have the source stated in the caption. Large paragraphs of quoted text will not be graded well.
- Follow a typical and consistent journal style for your citations.

- Avoid using websites such as Wikipedia as your cited sources. This can be a good starting point, but the material is not reviewed or checked for accuracy.

Example Topics

These are to give ideas, but there are many others to choose from. The topics should be separate from lecture topics or significantly beyond what is discussed in lecture. One good resource for possible topics is browsing the abstracts/categories of the Magnetism and Magnetic Materials conference program: http://magnetism.org/?page=program.

Materials

Magnetic shape memory alloys
Core-shell magnetic nanoparticles
Multiferroics or magnetoelectrics
Rare earth compounds

Magnetic garnets
Amorphous magnets
Monolayer magnetic films
1D/2D magnetic materials
Molecular magnets
Magnetic semiconductors
Superconducting/ferromagnetic interfaces
Ferrimagnetic materials
Antiferromagnetic materials
Half metals
Magnetocaloric materials
Topological materials

Spin Seebeck and magnetocaloric materials/effects
Measurement techniques for magnetic materials (MFM, MOKE, SQUID, VSM, AGM)
Magnetohydrodynamics and the Sun

Devices

Magnetic readback heads
Magnetic write heads
Hard disks or patterned media
Heat-assisted magnetic recording; microwave-assisted magnetic recording
Magneto-optical devices
Magnetic isolators or circulators
Magnetic shielding
Magnetophotonic crystals
MRI contrast agents
Biomarkers; magnetic hysteresis devices
MRAM
Magnetic field sensors
Magnetorheological fluids / ferrofluids; cooling
Memory and logic devices
Rashba and spin Hall based devices
Ultrafast switching devices
Inductors
Quantum computing devices
Neuromorphic computing devices

Magnetocaloric devices