

# MSE-381: MATERIALS FOR ENERGY-EFFICIENT TECHNOLOGY

## SYNOPSIS

This course is a **materials science approach** to the challenge of energy-efficient technology. It introduces first the concept of **materials energy content** (production, processing, use and recycling), with students developing individually and in group case studies in this area. It then describes how advanced materials make possible efficient energy **harvesting** (e.g., solar cells, nuclear materials, composites for wind energy, thermoelectrics), energy **transformation** (e.g., fuel cells, engines and turbines) and energy **storage** (e.g., hydrogen storage, batteries, capacitors). Finally, materials enabling energy-efficient **transportation** and **housing** (lighting, cooling and heating) will be discussed.

Students will choose a subject related to the course on which they will write a term paper and give an oral presentation. Two guest lecturers will be invited to describe their own areas of specialization.

<u>Room</u>	Tech L158
<u>Hours</u>	Tues. and Thurs. 2:00 - 3:20 PM
<u>Instructors</u>	Prof. David C. Dunand (dunand@northwestern.edu) Cook Hall 1129 office hours: Thursdays 5-6 pm or by appointment TA: Garret DeNolf (GarretDenolf2008@u.northwestern.edu) Cook Hall 2053A office hours – Tuesdays 3.30-5.30 pm or by appointment
<u>Grading</u>	Midterm Exam 35% (May 13) Term Paper 25% (due June 3) Case Study Paper 10% (due May 4) Oral Presentation 10% Homework 20% homework 1+2 (due April 13 + 20) 8% summary of 2 Hilliard energy talks (due May 20) 4% Wikipedia entry (due May 27) 4% summary of 1 NU energy talk * (due June 1) 4%
<u>Books</u>	McKay – Sustainable Energy without the Hot Air (free online version at: <a href="http://www.withouthotair.com">http://www.withouthotair.com</a> ) Ashby – Materials and the Environment, Butterworth 2009 (on reserve at engineering library)

\* check calendar on ISEN website. A few examples:

May 7 - Solar Fuels for the Future - The 3rd Annual ANSER Solar Energy Symposium  
May 28 - “Canadian-United States Energy Issues after Copenhagen: Oil Sands and Energy Interdependence.”

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## TIMETABLE

1	<b>March</b>	30	Sustainability and Energy Landscape	
2	<b>April</b>	1	Energy Landscape – a MSE approach	
3		6	Materials Life Cycle and Energy Content	
4		8	Materials Processing	
5		13	Materials Recycling	<b>Homework 1 due</b>
6		15	High Temperature Materials for Energy Conversion	
7		20	Materials for Nuclear Energy	<b>Homework 2 due</b>
8		22	Light-Weight Materials for Transportation	
9		27	Hydrogen Storage Materials ( <b>Wolverton</b> )	
10		29	Materials for Residential Buildings	<b>Case study presentation 1</b>
11	<b>May</b>	4	Materials for Lighting and Cooling	<b>Case study presentation 2</b>
12		6	Materials for Wind Energy	
13		11	Photovoltaic Materials	
14		13	<b>Midterm Exam</b>	
15		18	Nanostructured Materials for Photovoltaics ( <b>Lauhon</b> )	
16		20	<b>attend Hilliard symposium*</b>	
17		25	Materials for Batteries	
18		27	Materials for Fuel Cells	<b>Term paper Presentations 1</b>
19	<b>June</b>	1	Materials for Fuel Cells	<b>Term paper Presentations 2</b>
20		3	Thermoelectric Materials	<b>Term paper Presentations 3</b>

\* see homework requirement above.