

ME 290T Plasmonic Materials

Head Instructor: Prof. Xiang Zhang
Prerequisites: Physics 110A
Time/Location: TuTh 12:30-2:00 pm in 3113 Etcheverry Hall
<http://classes.berkeley.edu/content/2017-fall-meceng-290t-001-lec-001>
Office Hour: By appointment via email to <xz_asst-me@berkeley.edu>

Reference Books: Plasmonics: Fundamentals and Applications (by Maier)
Photonic Crystals: Molding the Flow of Light (by Joannopoulos et al.)
Optical Metamaterials: Fundamentals and Applications (by Cai and Shalaev)
Optical Properties of Solids (by Fox)
Classical Electrodynamics (by Jackson)

Course Outline:

Week 1 (8/29 – 8/31) **Introduction of Metamaterials and Plasmonics** (1 lecture)
Readings: Fox, Ch. 1, 2, 7, Maier, Ch. 1.2-1.5

Review of Electromagnetism (1 lecture)
Readings: Jackson, Ch. 6, 7

Week 2 (9/5 – 9/7): **Light Interactions with Matters** (1 lecture)
Readings: Fox, Ch. 1, 2, 7, Maier, Ch. 1.2-1.5

Light in Confined Structures: Photonic Waveguides/Cavities (1 lecture)
Readings: Jackson, Ch. 8

Week 3 (9/12 – 9/14): **Light in Periodic Structures: Photonic Crystals** (1 lecture)
Readings: Joannopoulos, Ch. 3, 4, 5

Surface Plasmons: Basics: Extended Modes (1 lecture)
Readings: Maier, Ch. 2

Week 4 (9/19 – 9/21): **Surface Plasmons: Basics: Localized Modes** (1 lecture)
Readings: Maier, Ch. 5

Surface Plasmons: Experiments and Techniques (1 lecture)
Readings: Maier, Ch. 3, 4

Week 5 (9/26 – 9/28): **Surface Plasmons: Devices and Applications** (1 lecture)
Readings: Maier, Ch. 7, 8, 9

 Metamaterials: Electric and Magnetic Responses, Negative Refraction, Superlens
(1 lecture)
Readings: Cai & Shalaev, Ch. 4, 5, 6, Maier, Ch. 11

Week 6 (10/3 – 10/5): **Cloaking and Transformation Optics, and PT optics** (2 lectures)

Week 7 (10/10 – 10/12): **Metasurfaces and Others Topics** (hyperbolic, devices, etc) (2 lectures)

Week 8 (10/17 – 10/19): **Mid-Term Project Presentation**
Presentation: 7 min. per student (5 min. talk, 2 min. Q&A); 4 slides max
Midterm Report: Due at 5 PM on 10/17

Week 9 (10/24 – 10/26):	Non-linear Optics, Quantum Optics and Spectroscopy (2 lectures)
Week 10 (10/31 – 11/2):	2D Materials and Devices (2 lectures)
Week 11 (11/7 – 11/9):	2D Materials and Devices (2 lectures)
Week 12 (11/14 – 11/16):	2D Materials and Devices (1 lecture + 1 experiment demo)
Week 13 (11/21 – 11/23):	No Class (Thanksgiving week)
Week 14 (11/28 – 11/30):	Final Project Presentation: 12 min. each (10 min. talk, 2 min. Q&A); 10 ppt max including cover slide. Final Report: Due at on 11/30, 2 pm in class.

Grading: midterm presentation (20%): 2-page-double-line report (20%), final project presentation (20%) and final report (40%) (10-page double-line report, Applied Physics Letters journal paper style). (The project will be based on a critical review of a topic of nanophotonics or a mini research project). Students will survey the literatures and discuss with instructor about the selection of the topic. Once the topic is identified (week 6), students are required to extensively review the topic in-depth. Students will need to provide critical comments on the literature/publications, and present their view of what can be done better, or their own ideas on what to do next.