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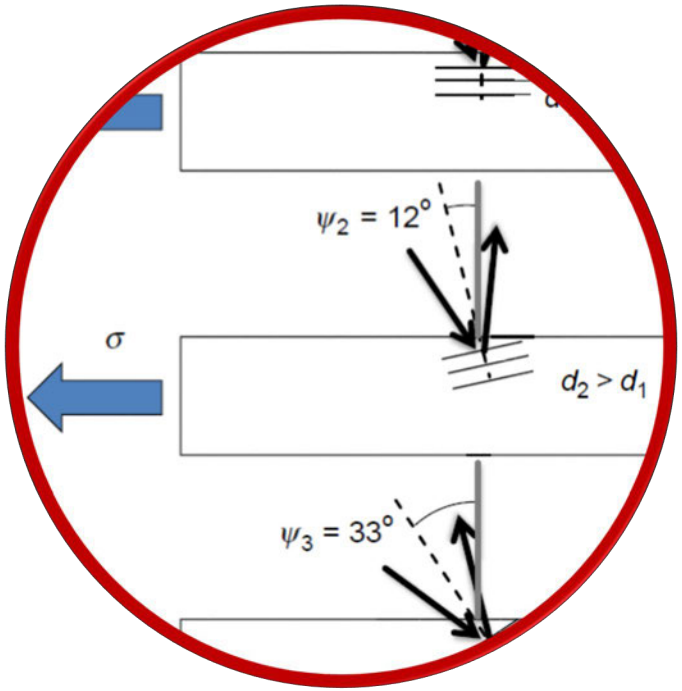
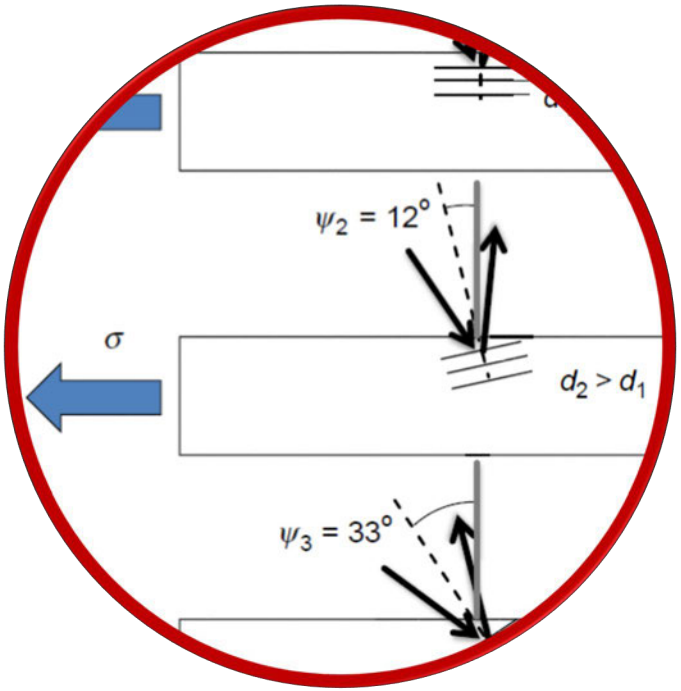
Thin film and small scale mechanics



Dr. Jakob Schwiedrzik, Prof. Johann Michler

Ch. 1: Introduction



Course outline

Content:

- Ch.1: Introduction
- Ch.2: Microstructure of Materials
- Ch.3: Materials mechanics
- Ch.4: Thin film mechanics
- Ch.5: Size effects
- Ch.6: Small scale mechanical testing
- Ch.7: Outlook

Course schedule

Time/Date	7.11.	8.11.	9.11.	10.11.
Room	L504	L504	L503	E3
9AM to 10AM				
10AM to 11AM				
11AM to 12PM				
12PM to 1PM				
1PM to 2PM				
2PM to 3PM				
3PM to 4PM				
4PM to 5PM				
5PM to 6PM				

Lecture
Lunch
Exam

Literature

Materials Science and thin films:

- William D. Callister Jr., David G. Rethwisch, Materials Science and Engineering: An Introduction, 10th Edition, ISBN: 978-1-119-40549-8, (2018), 992 Pages
- Ohring Milton (2002) Materials Science of Thin Films, Deposition and Structure, 2nd edition (2002), San Diego: Academic Press

Mechanics:

- J. Mencik, Mechanics of Components with Treated or Coated Surfaces, Doordrecht (Netherlands): Kluwer Academic Publishers (1996)
- L. B. Freund and S. Suresh, Thin Film Materials: Stress, Defect Formation and Surface Evolution, Cambridge University Press (2003)
- B. Bhushan (ed.), Handbook of Micro/Nanotribology 2nd edition, CRC Press (1998)
- B. Bhushan (ed.), Handbook of Nanotechnology, Springer Berlin (2004), ISBN 3-540-01218-4
- J. Rösler, H. Harders, M. Bäker, Mechanisches Verhalten der Werkstoffe, Teubner (2003), ISBN 3-519-00438-0

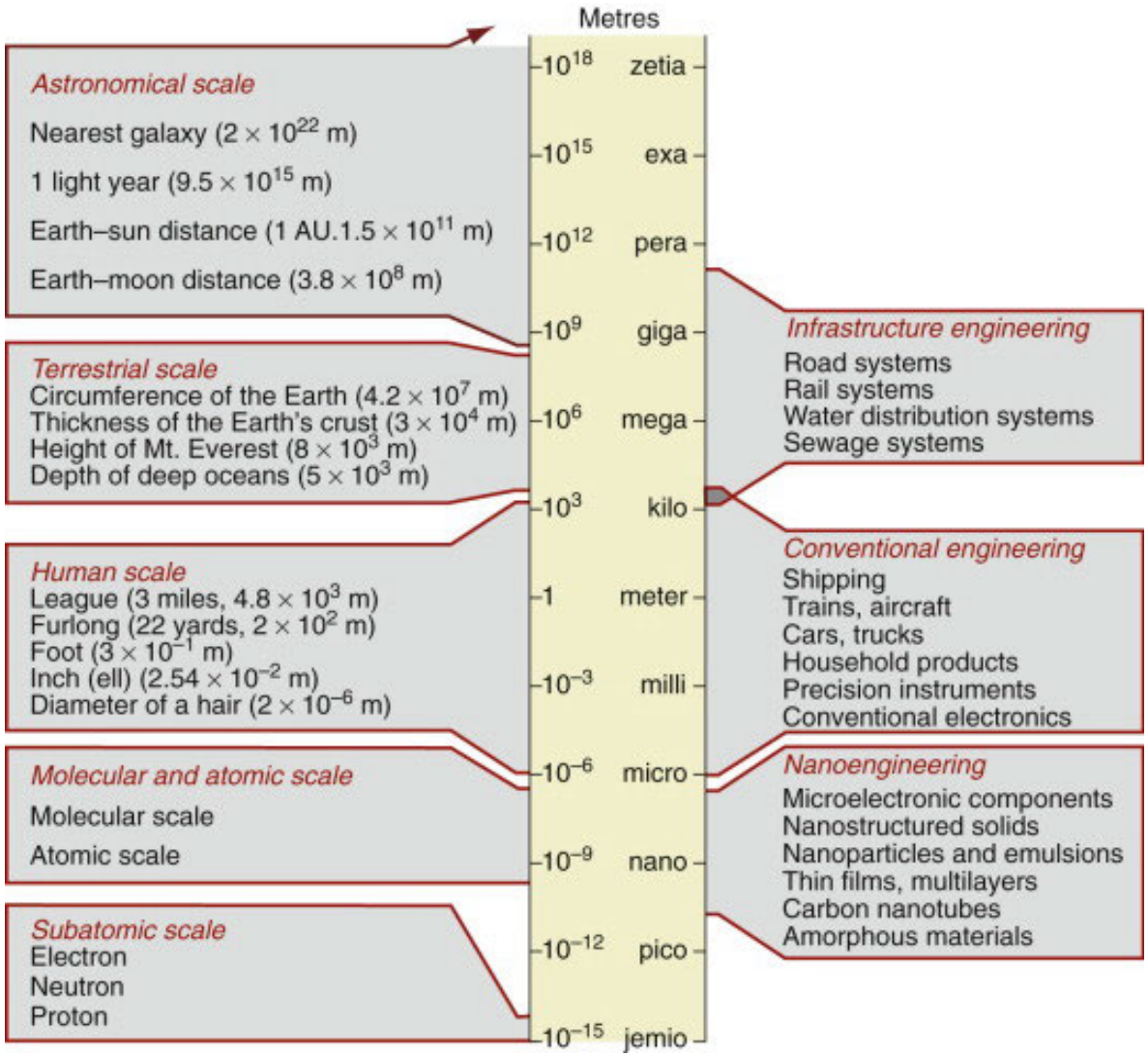
Nanoindentation:

- A. C. Fischer-Cripps, Nanoindentation, Springer New York (2002), ISBN 0-387-95394-9
- http://www.nanoindentation.cornell.edu/home_main.htm

Classification of „nano"

Physics:	manipulation of individual atoms
Chemistry:	manipulation of 10^{23} atoms
Materials Science:	materials property changes with at least one dimension smaller 100nm
Engineering:	accuracy (position etc.) below 100nm

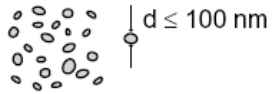
Length scales



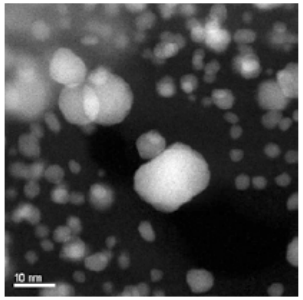
0-D to 3-D nanomaterials

0-D

All dimensions (*x*,*y*,*z*) at nanoscale

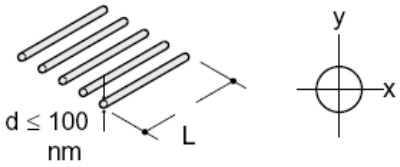


Nanoparticles

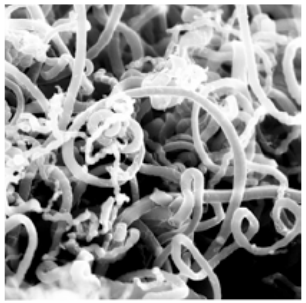


1-D

Two dimensions (*x*,*y*) at nanoscale, other dimension (*L*) is not

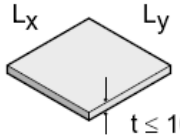


Nanowires, nanorods, and nanotubes

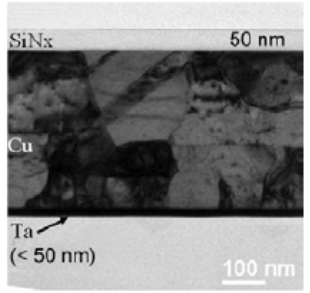


2-D

One dimension (t) at nanoscale, other two dimensions- (L_x, L_y) are not

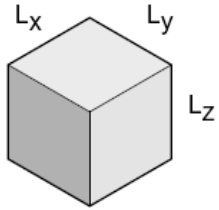


Nanocoatings and nanofilms

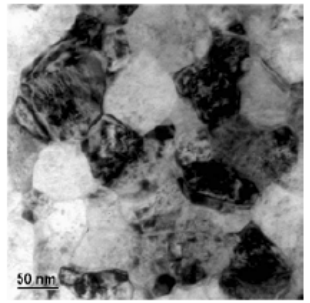


3-D

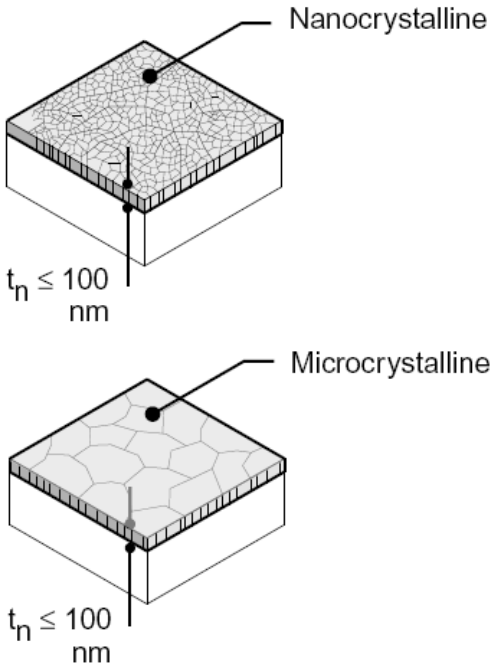
No bulk dimension at nanoscale

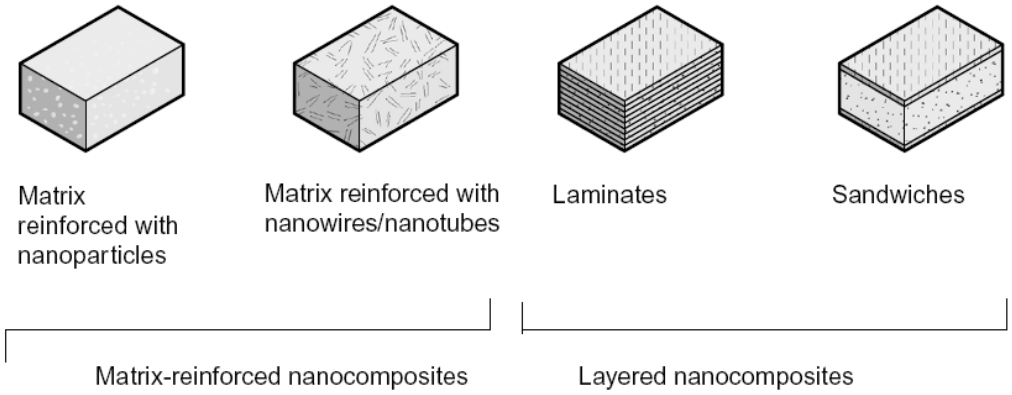


Nanocrystalline and nanocomposite materials



Internal vs. external dimension





The LEGO game