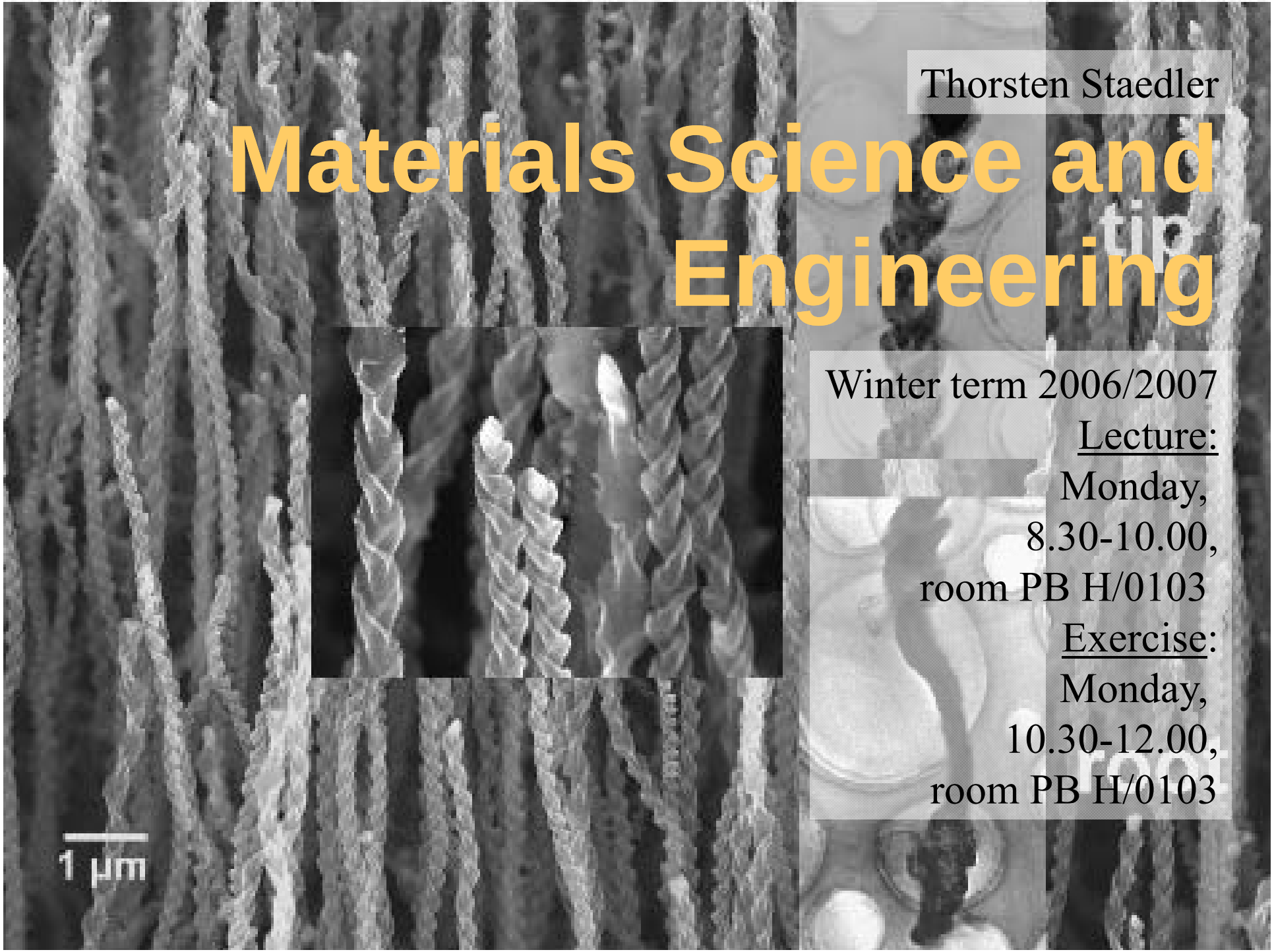


Thorsten Staedler

Materials Science and Engineering

Winter term 2006/2007

Lecture:
Monday,
8.30-10.00,
room PB H/0103

Exercise:
Monday,
10.30-12.00,
room PB H/0103

Organization of the Course

Lecture:
2 hours per week – ppt slides + blackboard

Exercise:
2 hours per week – questions and problems
to be solved in the group

Examination:
project work + presentation (small groups) approx. 30%
written exam (2 hours) at the end of the term (February) approx. 70%

Textbook:
W.D. Callister, Materials Science and Engineering.
An Introduction, Wiley 2003 (library: 85 ZLI 2053)

Questions & Problems/project work (Studienarbeit):
Dr. T. Staedler, PB H002/e-mail: thorsten.staedler@uni-siegen.de

Presentations

small groups (3 people)
subject has to be subdivided
preliminary discussion (November)
approx. 6 pages paper (template will be available)
20 minutes presentations (+10min discussion, end of term)

subjects:

Biomaterials
Micro-electro-mechanical systems MEMS
Nanostructures/Nanocomposites
Wear protection of cutting tools

Objective of the Course

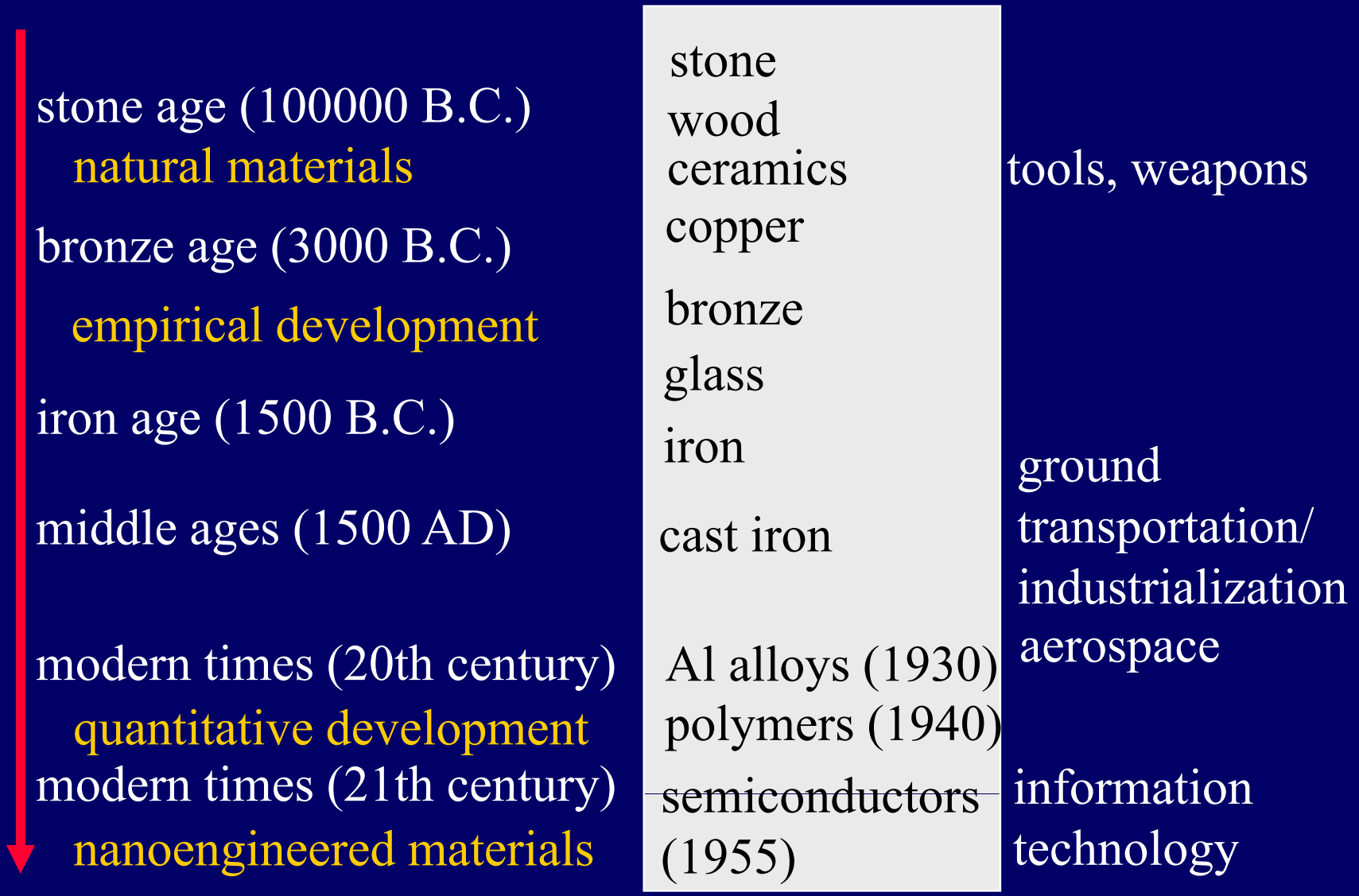
- provide basics in materials physics to understand the material behavior, i.e. microstructural changes, during application
- enable students to select appropriated materials from different classes for given applications
- enable students to apply suitable material testing and characterization procedures to support the engineering design process

Content 1st lecture

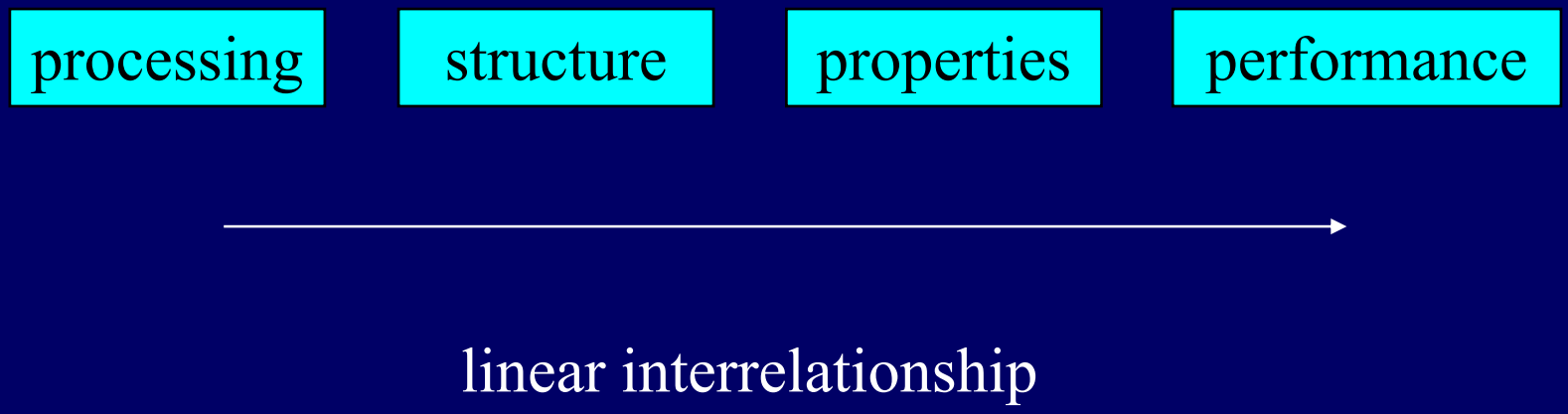
1 Introduction to materials science
and materials engineering

2 Atomic Structure of Materials

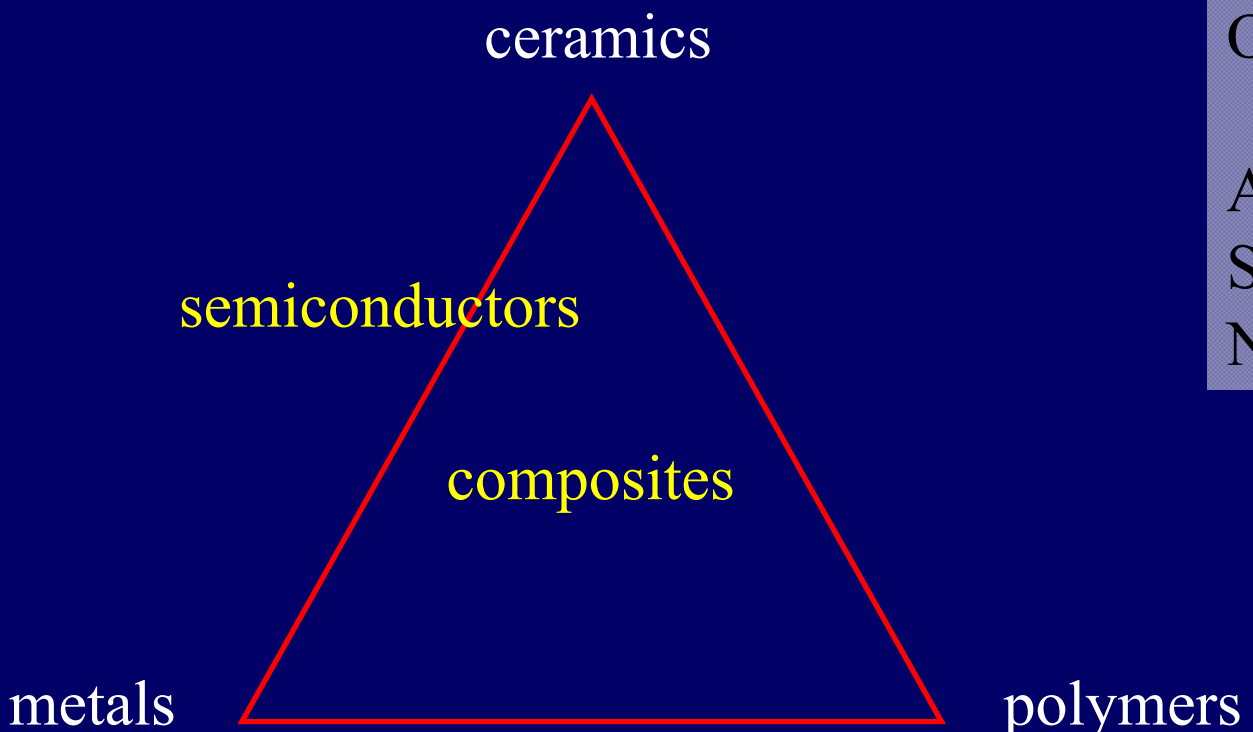
Historic Development



Materials science and engineering



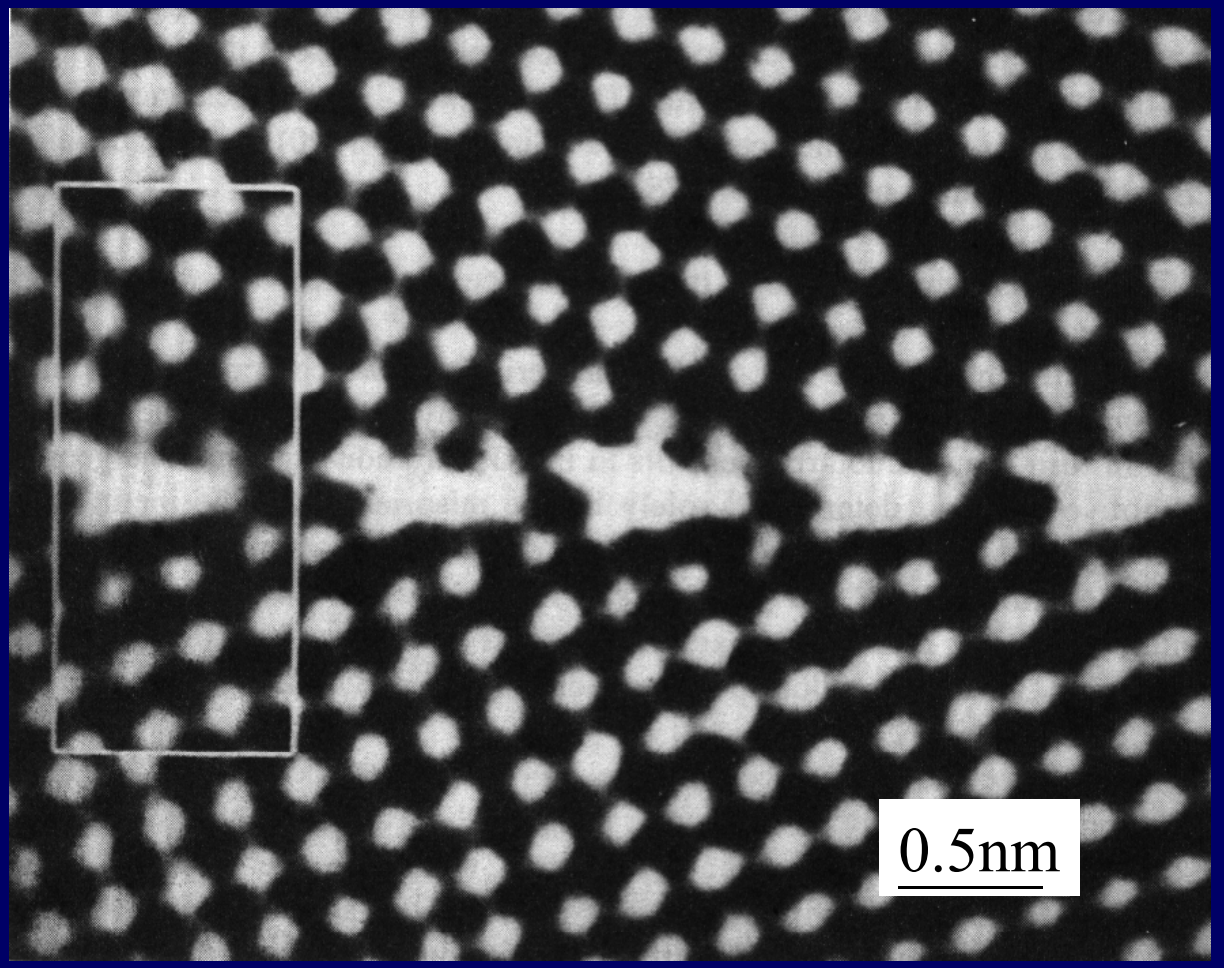
Materials classification



Other terms:

Advanced materials
Smart materials
Nanotechnology

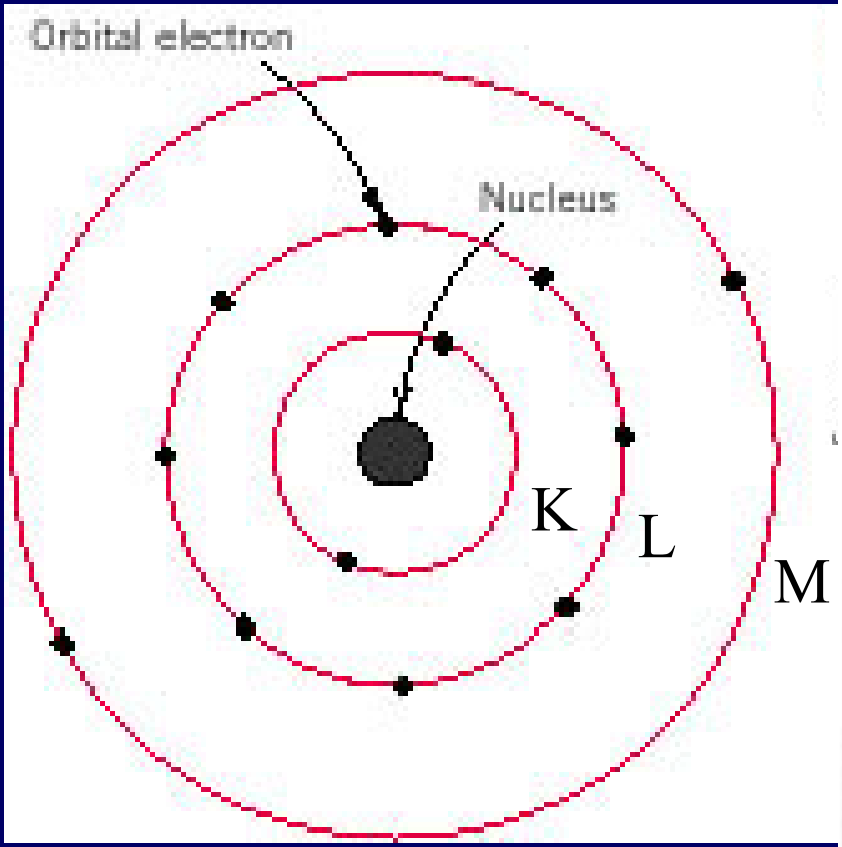
2 Atomic Structure of Materials



High-Resolution TEM micrograph

Atomic Models

Niels Bohr:



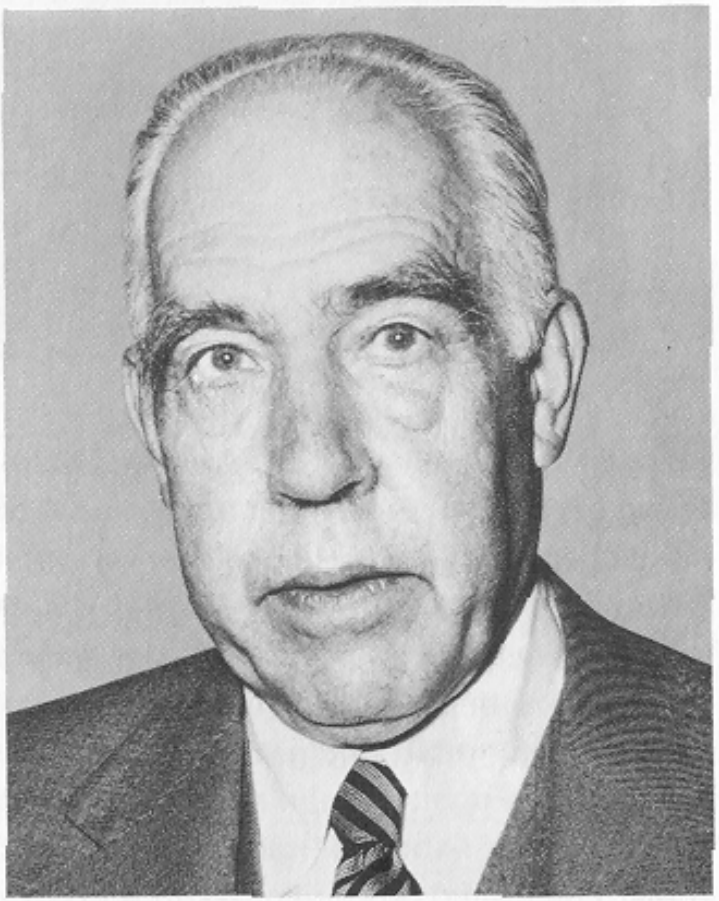


Abb. 2.19. N. Bohr

Pauli principle:

each electron state can hold no more than two electrons of opposite spin

Wave mechanical model

An electron is characterized by 4 parameters, so called quantum numbers

Principle quantum number n (1, 2, 3, …)

Second quantum number l (subshell) (s, p, d, or f)

Third quantum number m_l (energy states in a given subshell)

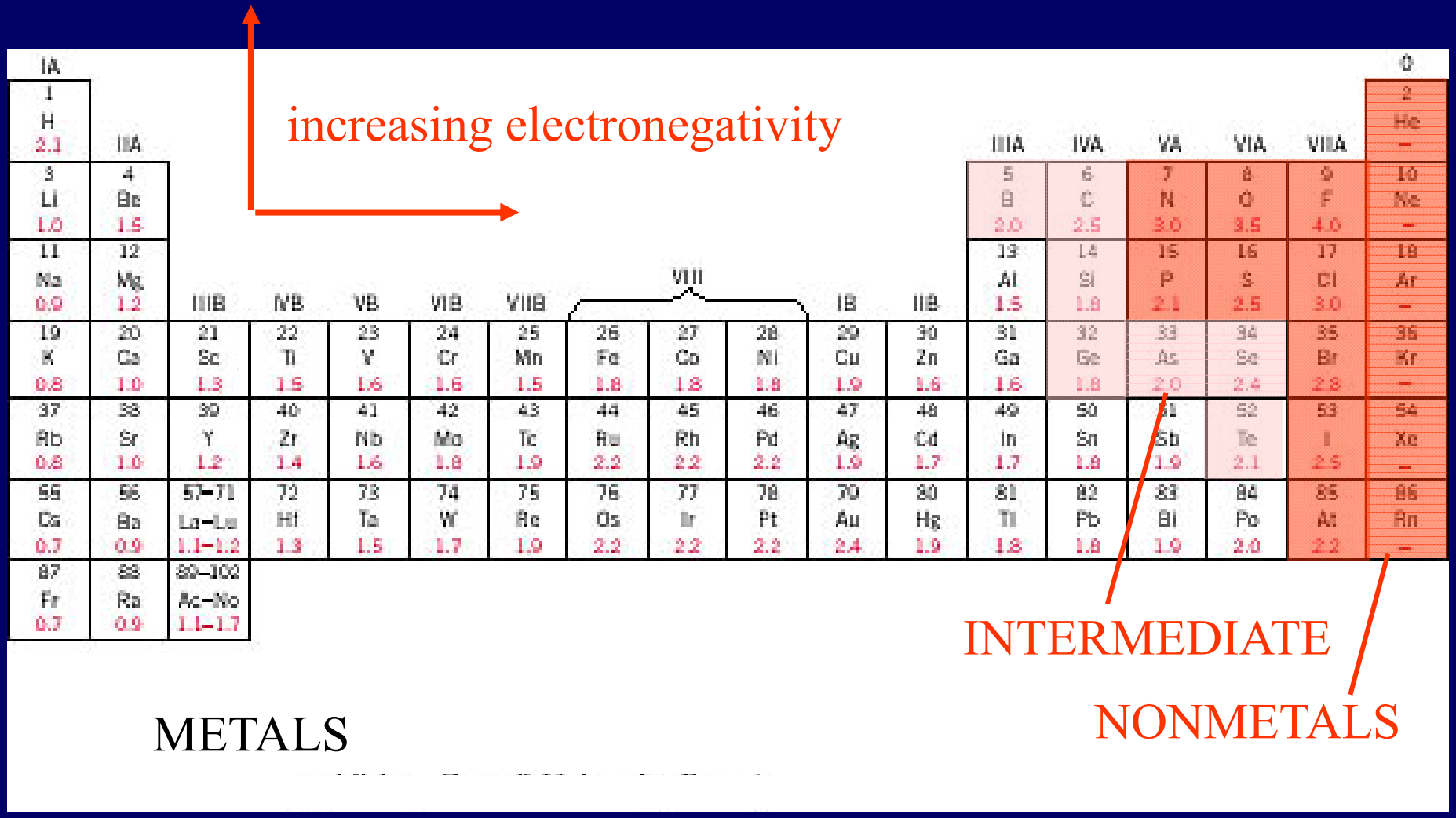
l=s → 1 state, =p → 3 states, =d → 5 states, =f → 7 states

Spin moment m_s – each state may have two spin orientations

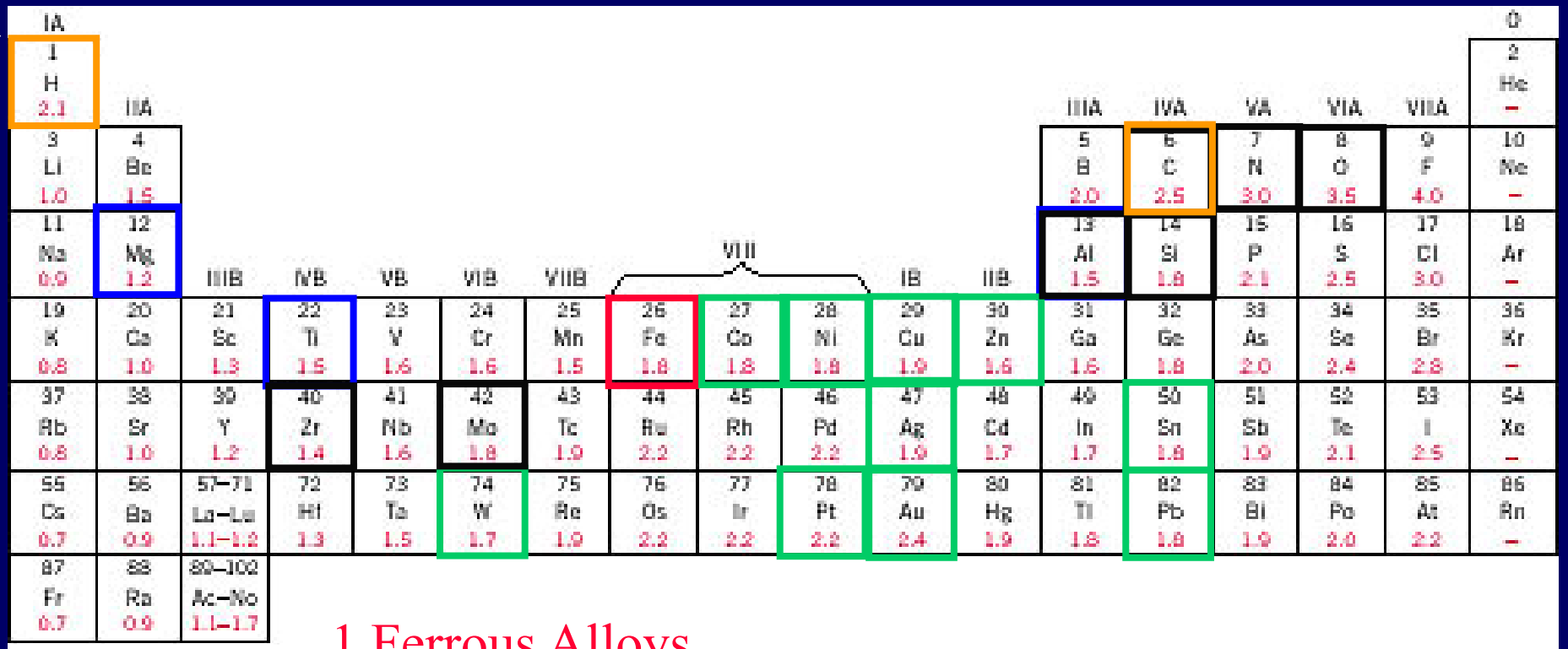
Example of an electron configuration: Sodium (ground state)

$1s^2 2s^2 2p^6 3s^1$

The Periodic Table



The Periodic Table



1 Ferrous Alloys

2 Non-Ferrous Alloys (light-weight, others)

3 Ceramics and Carbon Compounds

4 Polymers

Groups I,II (s) III,IV,V,VI,VII,0 (p) (number of valence electrons)

Break

Next lecture will cover

- Bonding in solids
- Structure of crystal solids