Сегодня: суббота,
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Workshop 1

Introduction into the discipline

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SMALL TALKS

- ✓ **Strangers**
- ✓ **People we don’t now well**
- ✓ **Parties, elevators, meetings, class, etc.**
- ✓ **Make people feel comfortable**

Everyday Conversations:

Formal Greetings

JAMES:	Good morning, Professor Austin, how are you doing?
PROFESSOR AUSTIN:	Good morning, James. I am doing well. And you?
JAMES:	I'm great, thank you. This is my friend Emma. She is thinking about applying to this college. She has a few questions. Would you mind telling us about the process, please?
PROFESSOR AUSTIN:	Hello, Emma! It's a pleasure to meet you. I'm more than happy to speak with you. Please stop by my office next week.
EMMA:	It's a pleasure to meet you, professor. Thank you so much for helping us.
PROFESSOR AUSTIN:	Don't mention it. Hopefully, I will be able to answer your questions!

LANGUAGE NOTES

- **The greetings *good morning/good afternoon/good evening* are used at different times of the day to greet people. "Good evening" is often used after 6 p.m. or generally when the sun has set.**
- **"Good night" is not a greeting: It is used when leaving a place or group of people. *Thank you and good night!/Good night, and see you tomorrow.***
- **When people meet in the United States, it is customary for them to shake hands. A handshake should be firm and usually lasts for about two to three seconds — which allows enough time to say "Nice to meet you."**
- **"Don't mention it" is another way of saying "You're welcome." The phrase "You are welcome" is more formal. However, responses such as *Don't mention it./No problem./Happy to help.* are informal ways of responding to a thank you.**

Business

Topics that are not allowed for conversation

- **Politics,**
- **religion,**
- **sports achievements of a particular team,**
- **Weather, office**

- **the level of the interlocutor**
- **Spare us the theatrics, fake compliments**
- **flexibility in the conversation (a person is not interested)**
- **avoid blanks (intimacy in communication)**

Informal Greetings and Farewells

JANE: Hi, Helen! How's it going?

HELEN: Fine, thanks — and you?

JANE: Just fine. Where are you off to?

HELEN: To the library. I've got a history exam next week and need to start studying. Ugh.

JANE: Oh, no. Well, I'll see you later then. Good luck!

HELEN: Thanks. See you later.

LANGUAGE NOTES

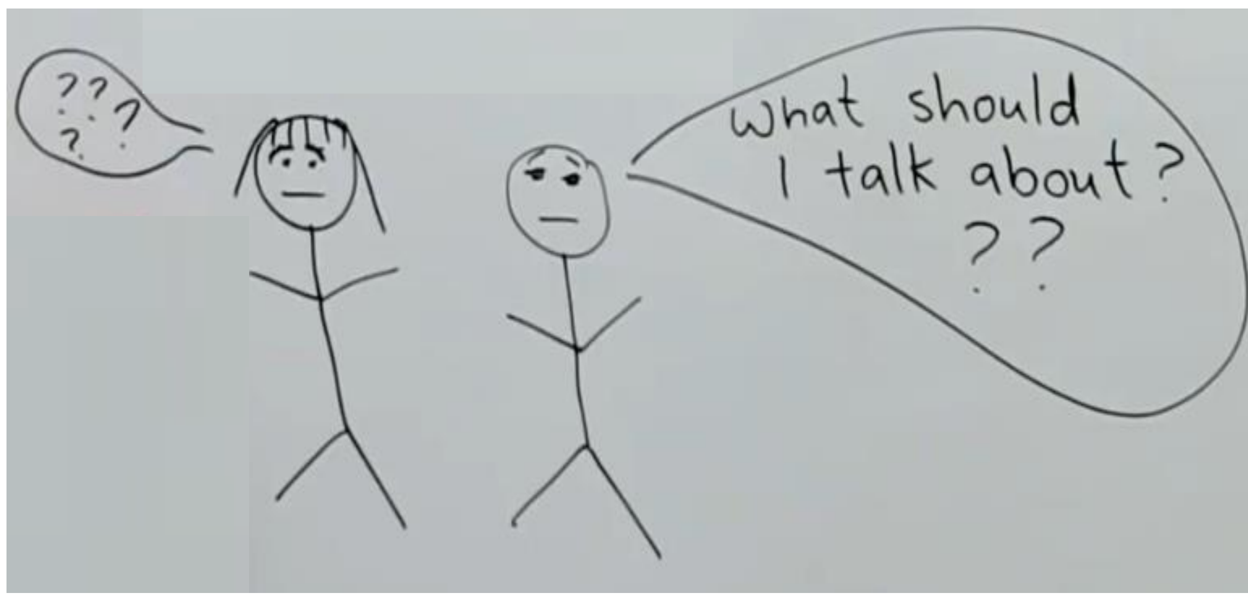
- **“Hi” is an informal way of saying “hello.” Notice that the “i” sound in “hi” is extended, to show that Jane is very pleased to see Helen.**
- **“How’s it going?” is an informal way of saying “How are you?”**
- **“Fine, thanks—and you?” Notice the rising intonation on “and you?” This shows that Helen is interested in what Jane has to say.**
- **“Where are you off to?” is an informal way of saying “Where are you going?” Notice the falling intonation since this is an information question, not a “yes/no” question.**
- **“To the library.” Notice that Helen does not say “I’m going” here because that information was already established in the question “Where are you off to?”**
- **“Oh, no” is a way of saying “I sympathize with you” or “I understand you are not happy.”**
- **“See you later” is an informal way of saying “goodbye.”**

INFORMAL CONVERSATION

Better conversation with FORD

Family
Occupation
Recreation
Dreams

Keep it light/easy
Make the person comfortable with comfortable topics
Find similarities
Smile, listen, learn



Occupation

What's keeping you busy these days?

That's interesting! How did you get involved with that?

How long have you been in your field?

What's the best part of your job?

No talk on $$$ X

Family

Where are you from originally?

Where did you grow up?

Do you still have family there?

How did you meet ______?

Do you have any brothers or sisters?

Do you come from a big family?

How is your family? How are your children?

What's your dog's name?

Dreams

Any plans for the summer?

If you could travel anywhere, where would you go?

What will you do once you finish that project? course?

What do you want to read next?

Recreation

What do you do for fun?

Do you play any sports?

Have you seen any good movies recently?

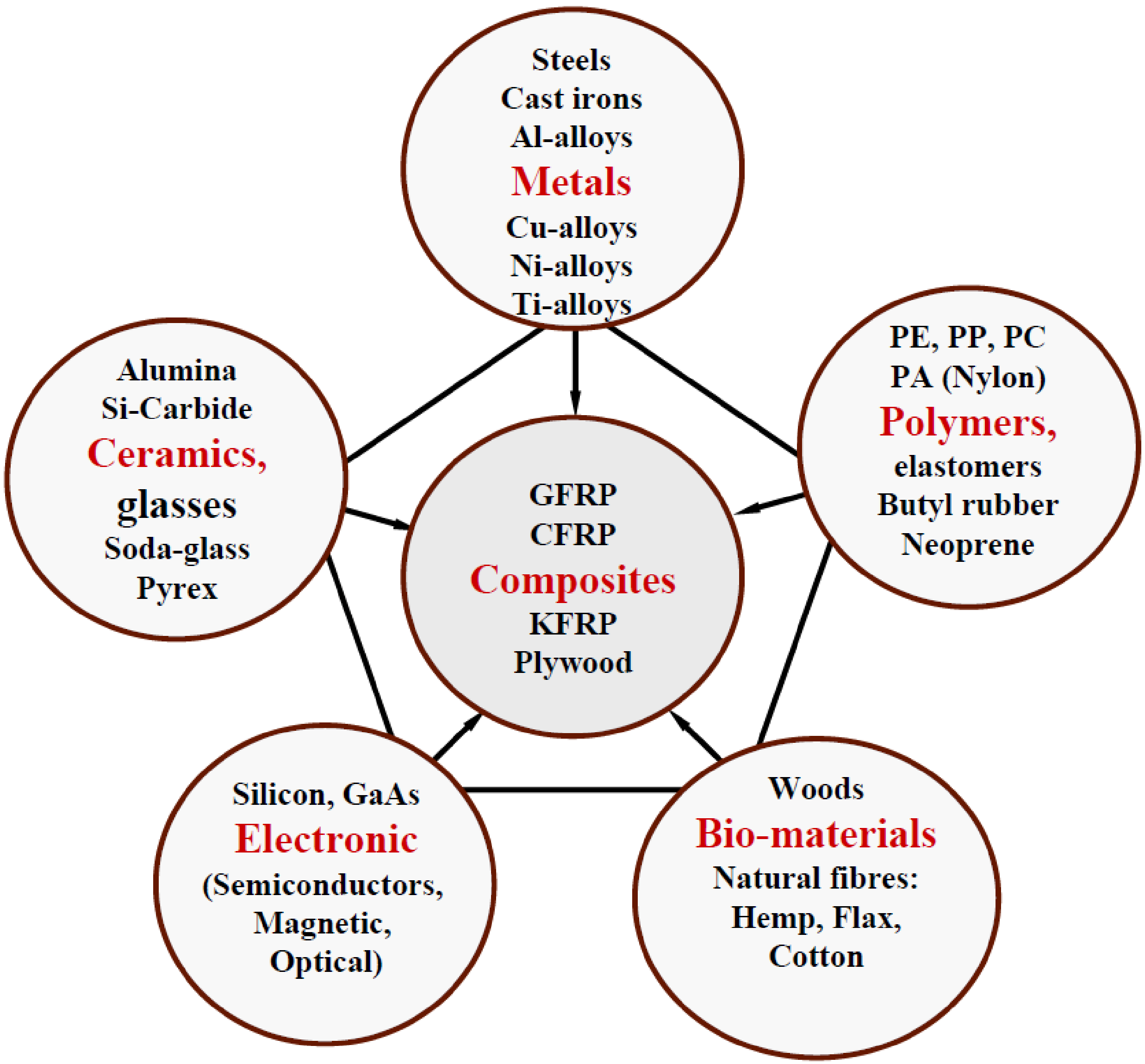
How did you become interested in that?

Did you hear Radiohead's new album?

WAS: Home task #1

- **Prepare, write and present 2 dialogs on Formal/Informal Greetings and Farewells.**

The world of materials:



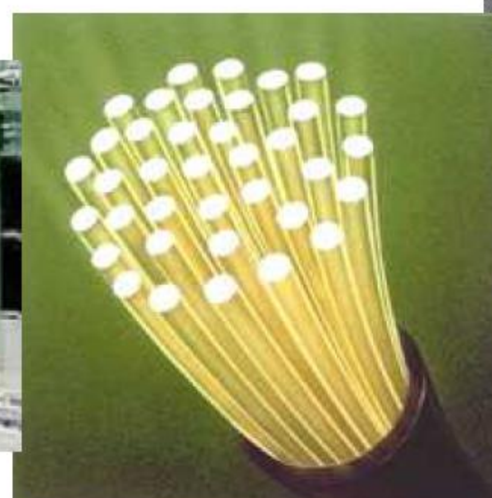
Important properties of solid materials

- **mechanical,**
- **electrical,**
- **thermal,**
- **magnetic,**
- **optical, and**
- **Deteriorative (get worse)**

Solids

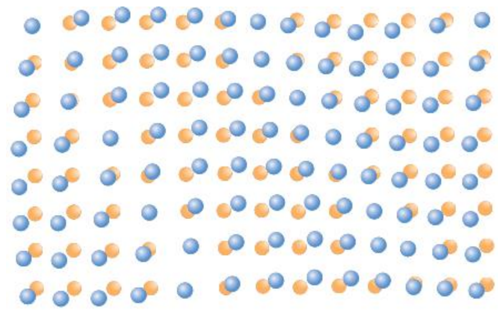
we are interested in their mechanical properties…

we are interested in their electronic properties…

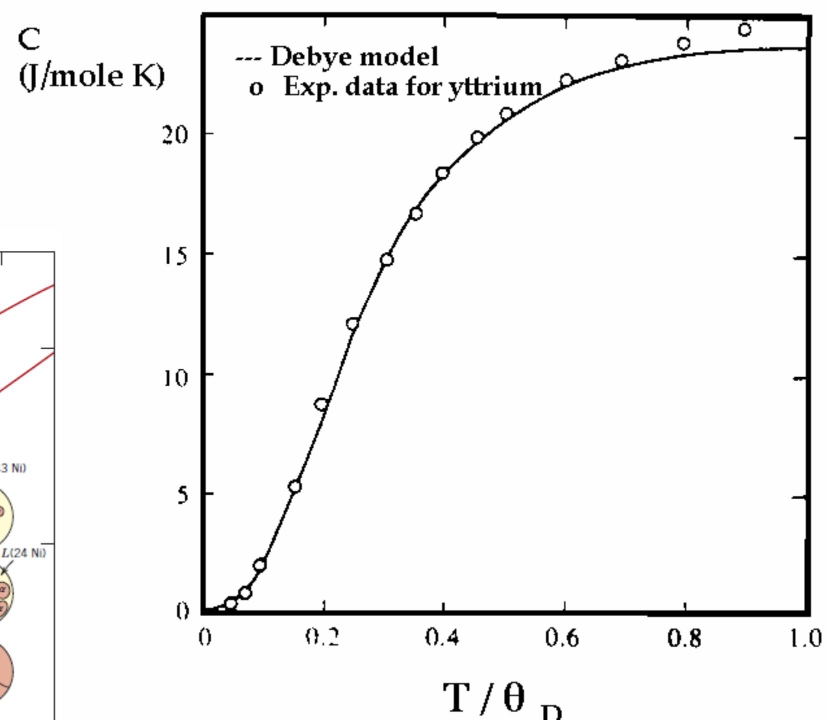


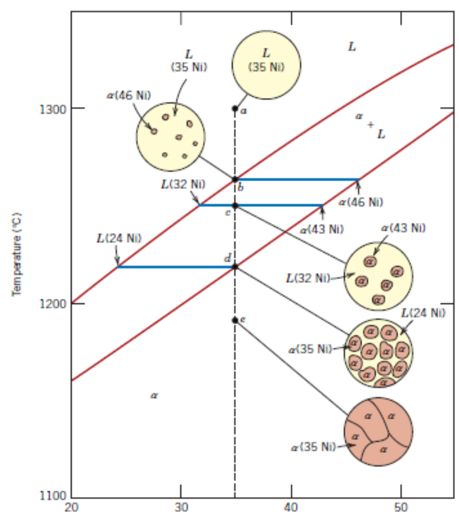
We are interested in thermal properties …

THERMAL CONDUCTIVITY



Heat Capacity





THERMAL EXPANSION

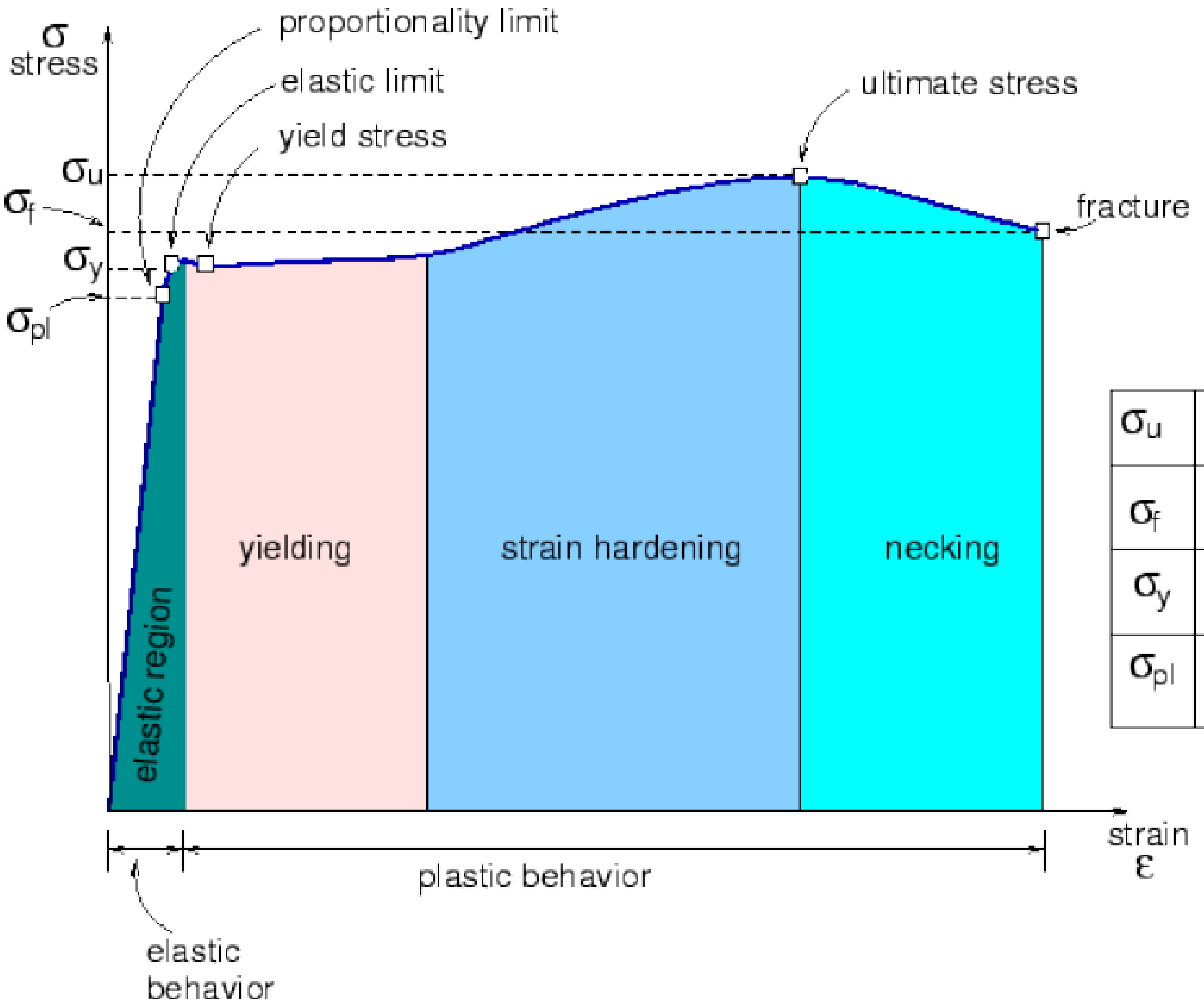
We are interested in Deteriorative properties …

Radiation Effects

Chemical Reaction

Corrosion and Degradation of Materials

Part 2. Let's remember



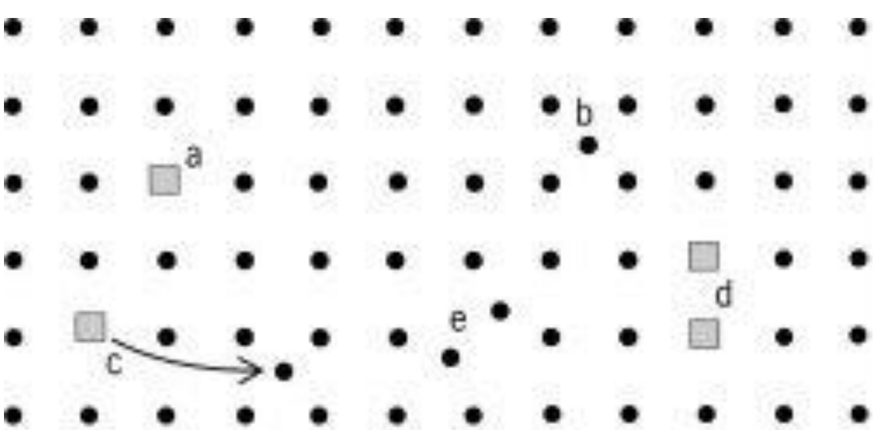
σ_u	Ultimate stress
σ_f	Fracture stress
σ_y	Yield stress
σ_{pl}	Proportionality limit

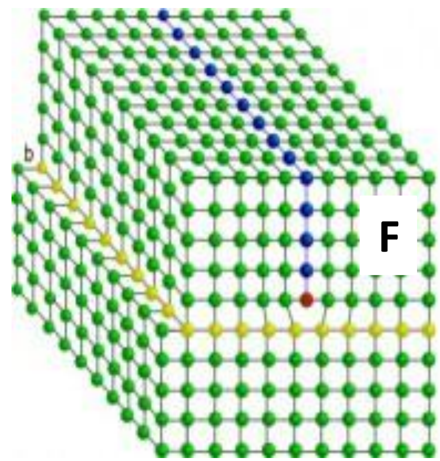
Quiz

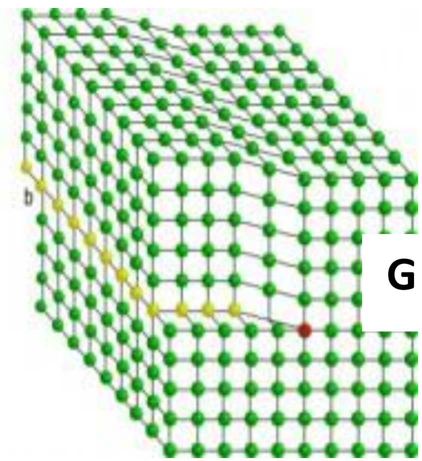
1. **What is Hook’s law?**
2. **What is elastic and proportional limit?**
3. **How is the elastic modulus measured from the stress-strain curve?**
4. **What is yield stress?**
5. **What is 0.2% proof stress?**
6. **What is ductile and brittle behavior?**
7. **What is true stress and strain. Deduce the relationship between true and engineering stress and strain.**
8. **What is shear stress and strain**
9. **What is Poisson's ratio?**
10. **What are structure-sensitive and structure insensitive properties?**

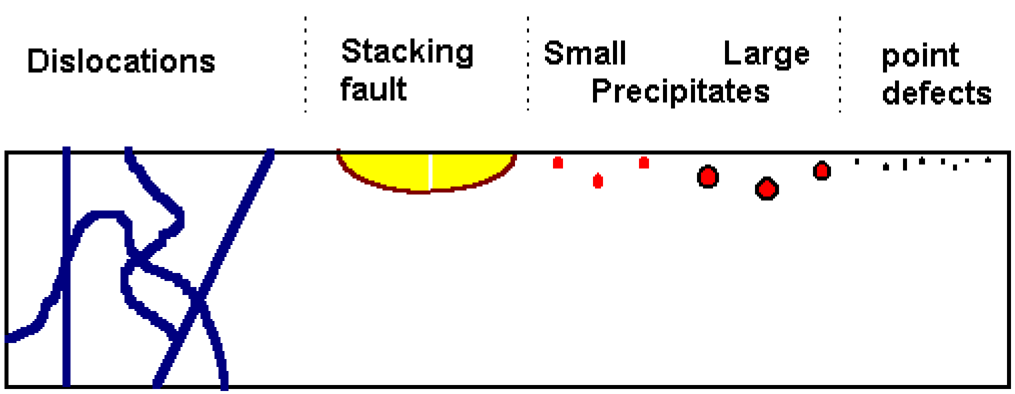
Part 2a. Defects and solid solution hardening

Task 1. List all possible defects of crystals, you know, and give a definition to them.

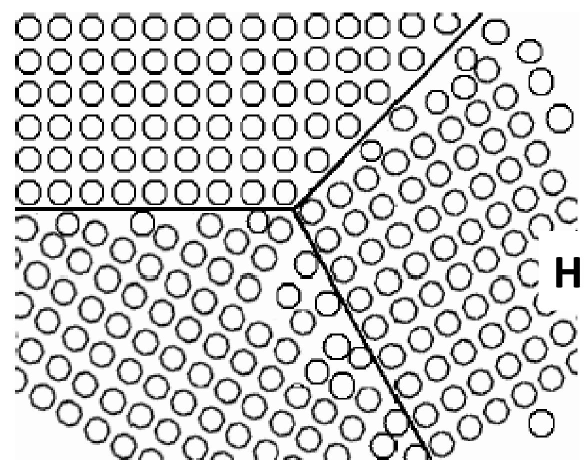








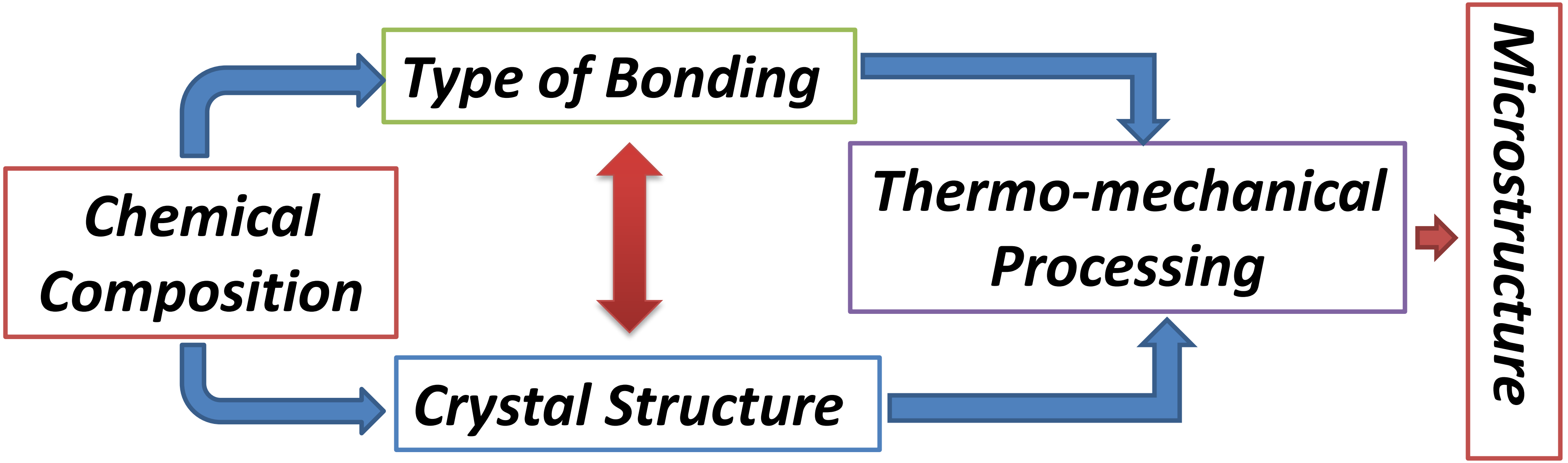
Crystal with Defects



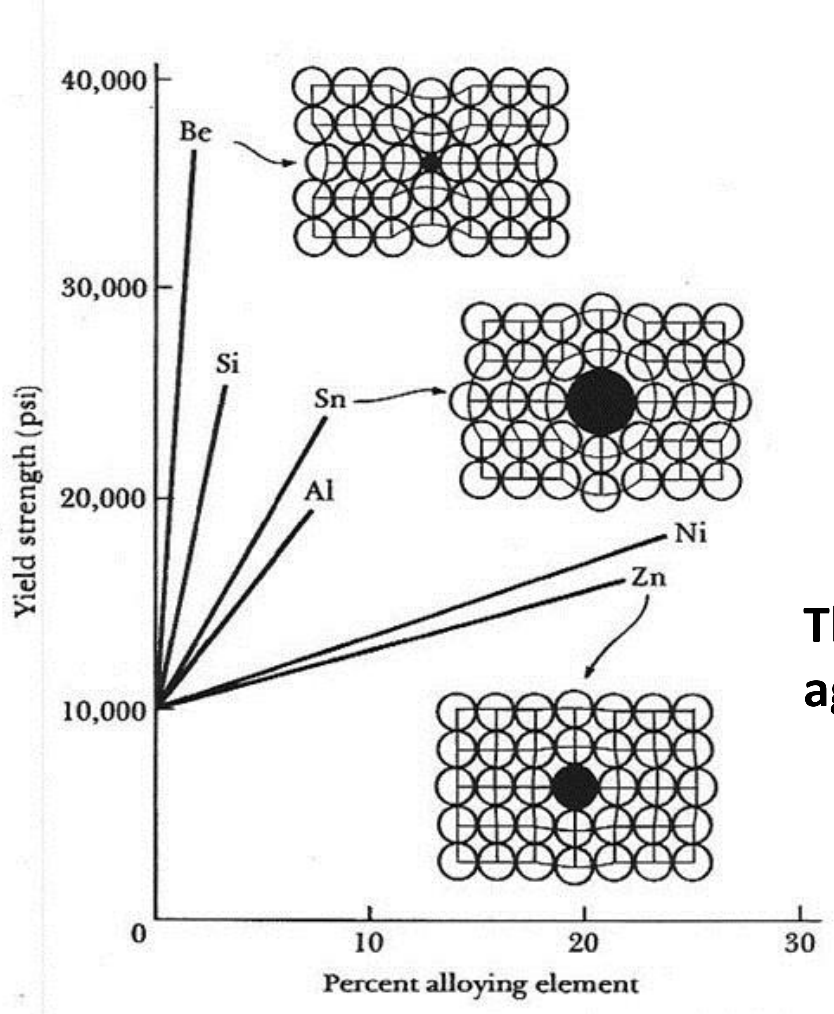
The defects have a profound effect on the macroscopic properties of materials

Bonding + Structure + Defects = Properties

The processing determines the defects



Part 2b. Solid solution hardening



***Task 2:* Study the picture on the left and discuss possible reasons for significant changes of strength and plastic properties of copper**

Task 3: What is solid-solution strengthening?

The number of vacancies formed by thermal agitation follows an Arrhenius type of equation:

$$N_V = N_A \exp\left[-\frac{Q_V}{kT}\right]$$

where N_A = the total number of atoms in the solid,
Q_V = the energy required to form a vacancy (per atom or per mole),
k = Boltzmann constant, R = the gas constant and
T = the temperature in Kelvin.

Example: Calculate equilibrium number of vacancies per cubic meter for copper at 1000^{o}C

Given:

Activation Energy per vacancy = 0.9 eV/atom;
atomic weight of copper = 63.5 g/mol ;
and density at 1000^{o}C = 8.40 g/cm^{3}
Boltzmann's constant k_B=1.38 × 10^{-23}J/K = 8.62 ×10^{-5}eV/K

Solution:

Determine *N*, number of atomic sites per cubic meter for *Cu*

$$N = \frac{N_a \rho}{A_{Cu}} = \frac{\left(6.023\times 10^{23}\,\frac{atoms}{mol}\right)\left(8.40\,\frac{g}{cm^3}\right)\left(10^6\,\frac{cm^3}{m^3}\right)}{63.5\,\frac{g}{mol}} = 8.0\cdot 10^{28}\,\frac{\text{atoms}}{\text{m}^3}$$

Thus, the number of vacancies at 1000ºC (1273 K) is equal to:

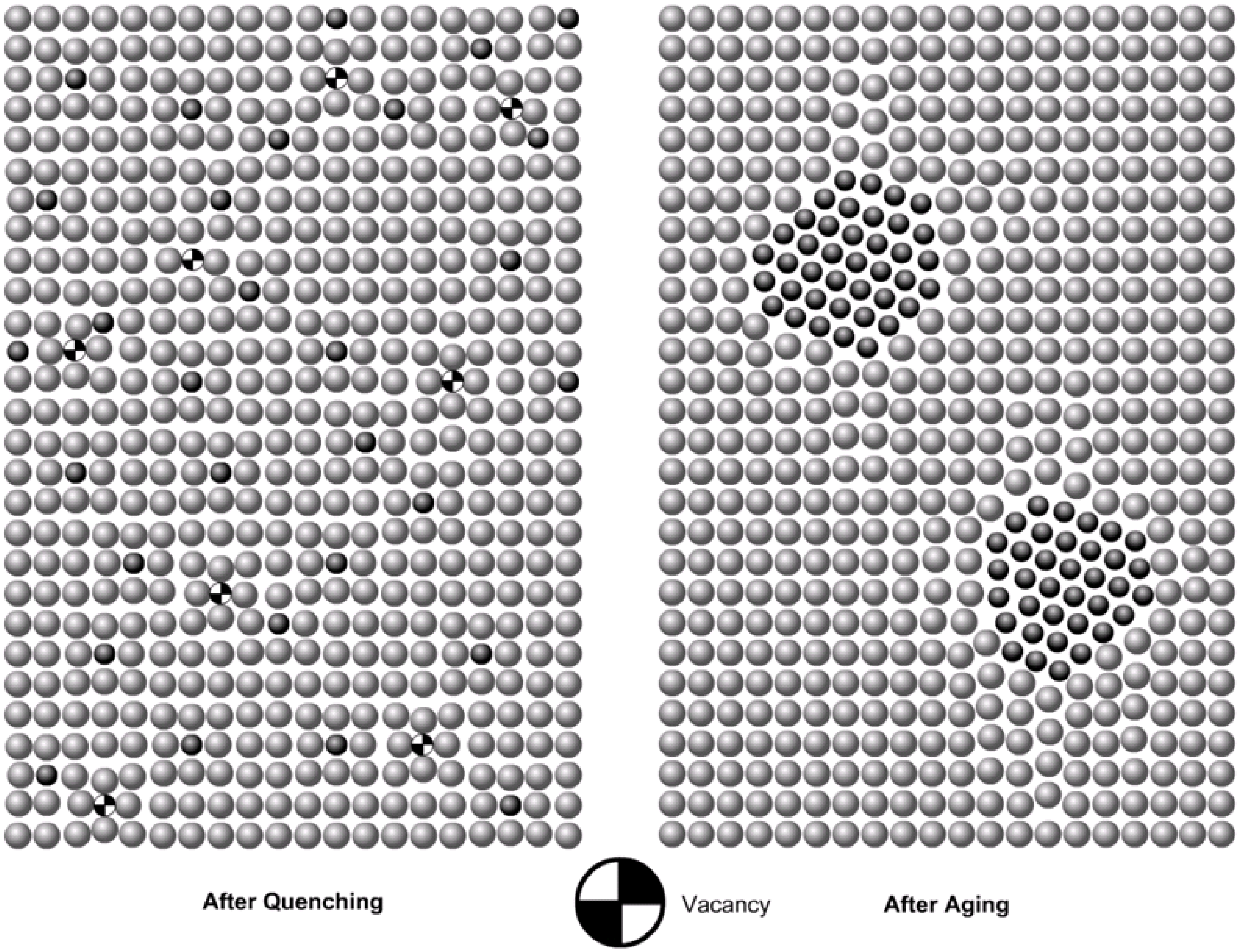
$$N_v = N\exp\left(-\frac{Q_v}{kT}\right) = \left(8\cdot 10^{28}\,\frac{\text{atoms}}{\text{m}^3}\right)\exp\frac{(0.9\text{eV})}{\left(8{,}62\cdot 10^{5}\,\frac{\text{eV}}{\text{K}}\right)(1273\text{K})} = 2.2\cdot 10^{25}\,\frac{\text{vacancies}}{\text{m}^3}$$

Home task #2

Calculate the equilibrium number of vacancies per cubic meter for silver at 800°C. The energy of vacancy formation is 1.10 eV/atom; the atomic weight and density (at 800°C) for silver are 107,9 g/mol and 9,5 g/cm^3, respectively. Boltzmann's constant k = 8,62 x10^{-5}eV / atom·K. Write your solution and be ready to explain it (orally). You should be able to read all mathematical expressions.

Part 2c. Precipitate hardening

Task 2: ***Study the pictures and discuss possible reasons for significant changes of strength and plastic properties of this material***



Examples: **Calculate the critical radius (in nanometers) of a homogeneous nucleus that forms when pure liquid copper solidifies. Assume ΔT(undercooling) = $0.2T_{melt}$.**

Given: For *Cu* $T_m = 1083^oC$;

Heat of fusion $\Delta H_f = 1826\ J/cm^3$;

Surface Energy $\gamma = 177x10^{-7}\ J/cm^2$;

Lattice parameter of FCC copper $a = 0.361$ nm.

Calculate the number of atoms in the critical-sized nucleus at this undercooling.

Solution:

We make use of the equation for a spherical nucleus to calculate the size of the critical nucleus

$$r_0 = \frac{2\gamma T_m}{\Delta H_f \Delta T} = \frac{2\left(177 \cdot 10^{-7}\, J.cm^{-2}\right)T_m}{\left(1826 J.cm^{-3}\right)\left(0.2T_m\right)} = 9.69 \cdot 10^{-8}\, cm = 0.969nm$$

Then, the volume of the critical nucleus is

$$V_{crit\_nucleus} = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(0.97\right)^3 = 3.82nm^3$$

The volume of an FCC cell is

$$V_{cell} = a^3 = \left(0.361nm\right)^3 = 0.047nm^3$$

The number of cells in the critical nucleus is

$$\frac{V_{crit\_nucleus}}{V_{cell}} = \frac{3.82nm^3}{0.047nm^3} = 81.34\,\text{cells}$$

As the number of atoms in an FCC cell is 4 then the total number of atoms is

$$\text{total number of atoms} = 4 \cdot 81.34 = 325\ \text{atoms}$$

Home task #3

Q.3 For the solidification of iron, calculate the critical radius *r and the activation free energy G* if nucleation is homogeneous. Values for the latent heat of fusion and surface free energy are $-1.85.10^9$ J/m^3 and 0.204 J/m^2, respectively. Use the supercooling value found in Table 1.**
(b) Now calculate the number of atoms found in a nucleus of critical size. Assume a lattice parameter of 0.292 nm for solid iron at its melting temperature.

metal	$\Delta T(^0C)$
Germanium	227
Silver	227
Gold	230
Copper	236
Iron	295
Nikel	319
Cobalt	330
Palladium	332