

Exercise for the Lecture on Materials Science

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Exercise Sheet 1

Discussion on 30 April 2025

Exercise 1

Complete the following table by providing a suitable description for each material class regarding the listed properties.

Property	Metals	Glasses	Ceramics	Polymers	Elastomers	Hybrid Materials
Elastic modulus						varying
Strength						
Impact toughness						
Formability		with T		easy		
Hardness						
Thermal conductivity						
Electrical conductivity	high					
Corrosion behavior						
Brittleness						
Optical properties	shiny					

Exercise 2

- a) A material is to be selected for the teeth of an excavator bucket. The most important properties of the material must be determined. What are they? Justify your answer based on the intended use.



- b) A material is to be selected for an energy-efficient cooking pot. What are the most important material properties for this application? Justify your answer!



- c) What are the essential and desirable requirements for materials used in single-use water bottles that aim to have minimal environmental impact?



Exercise 3

- a) Show that for the hexagonal close-packed (hcp) structure, the ratio $c/a = 1.633$.
- b) Lithium has a bcc crystal structure, an atomic radius of 0.152 nm, and an atomic mass of 6.94 g/mol. Calculate the density of lithium and compare the result with measured data.

Exercise 4

- a) Show that the cation-anion size ratio R_c/R_a for ionic crystals with a coordination number of 8 must be at least 0.732.
- b) Derive the packing densities for the fcc (0.74) and bcc (0.68) structures.

Exercise 5

- a) Draw the repeat unit of polyvinyl alcohol (PVAL) and calculate its molar mass M_0 .
- b) The molar mass M of a given PVAL sample is measured to be 10 kg/mol. How many repeat units N are contained in one PVAL molecule?