Structural metallic materials

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Interest:

- engine high temperature material research
- aircraft structure fatigue failure analysis

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1. Introduction to Engineering Materials

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1.1 HISTORICAL PERSPECTIVE

- Early civilizations have been designated by level of materials development
  (Stone Age, Bronze Age, Iron Age)

- Characteristics of materials meet the needs of modern society(Roman-Lead-$Pb(C_2H_3O_2)_2$)-84 VS30 ppm

- Suitable materials make our existence so comfortable

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1.2 MATERIALS SCIENCE AND ENGINEERING

- Materials science VS Materials engineering
- Materials scientist VS Materials engineer
- Structure and Property

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The Notion of structure----------nebulous term

- Subatomic structure----(electrons/individual atoms /nuclei)
- Atomic level----(atoms or molecules)
- Microscopic level----(large groups of atoms)
- Macroscopic level----(viewed with naked eye)

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The Notion of property----------elaboration

- Response to a specific imposed stimuli
- Independent of material shape and size

Six different categories:

- Mechanical
- Electrical
- Thermal
- Magnetic
- Optical
- Deteriorative

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The four components of the discipline of materials science and engineering and their interrelationship

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The four components of the discipline of materials science and engineering and their interrelationship

Steels							
Processing		Diffusion		Recrystallization		Isothermal transformation diagrams, continuous cooling transformation diagrams; heat treating for tempered martensite	Heat treatment of steels
Structure	Cristal structure, polymorphism				Development of microstructure , iron-iron carbide alloys	Microstructure of various microconstituents	
Properties		Solid solutions, dislocations	Mechanical properties	Dislocations, slip systems, strengthening mechanisms	Phase equilibria, the iron-iron carbide phase diagram	Mechanical properties of Fe-C alloys	
Performance							Applications of steel alloys

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Class-ceramics				
Processing		Continuous cooling transformation diagrams	Concept of viscosity	Crystallization, fabrication, Heat treatment
Structure	Noncrystalline solids		Atomic structure of silica glasses	*Polycrystallinity*
Properties				Mechanical, thermal optical properties Opacity and translucency in insulators
Performance				Applications

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Polymer Fibers				
Processing			Polymerization, additives, melting, fiber forming; Melting temperature, factors that affect;	
Structure	Electronic structure Interatomic bonding	Polymer molecules, polymer Crystal		
Properties		Thermoplastic polymers	Melting temperature factors that affect Mechanical properties, factors that affect	Degradation
Performance			Applications	

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Silicon Semiconductors				
Processing		Composition specification	Diffusion	Integrated circuits
Structure	Electronic structure Interatomic bonding			Electronic band structure
Properties				Electrical properties
Performance				Integrated circuits

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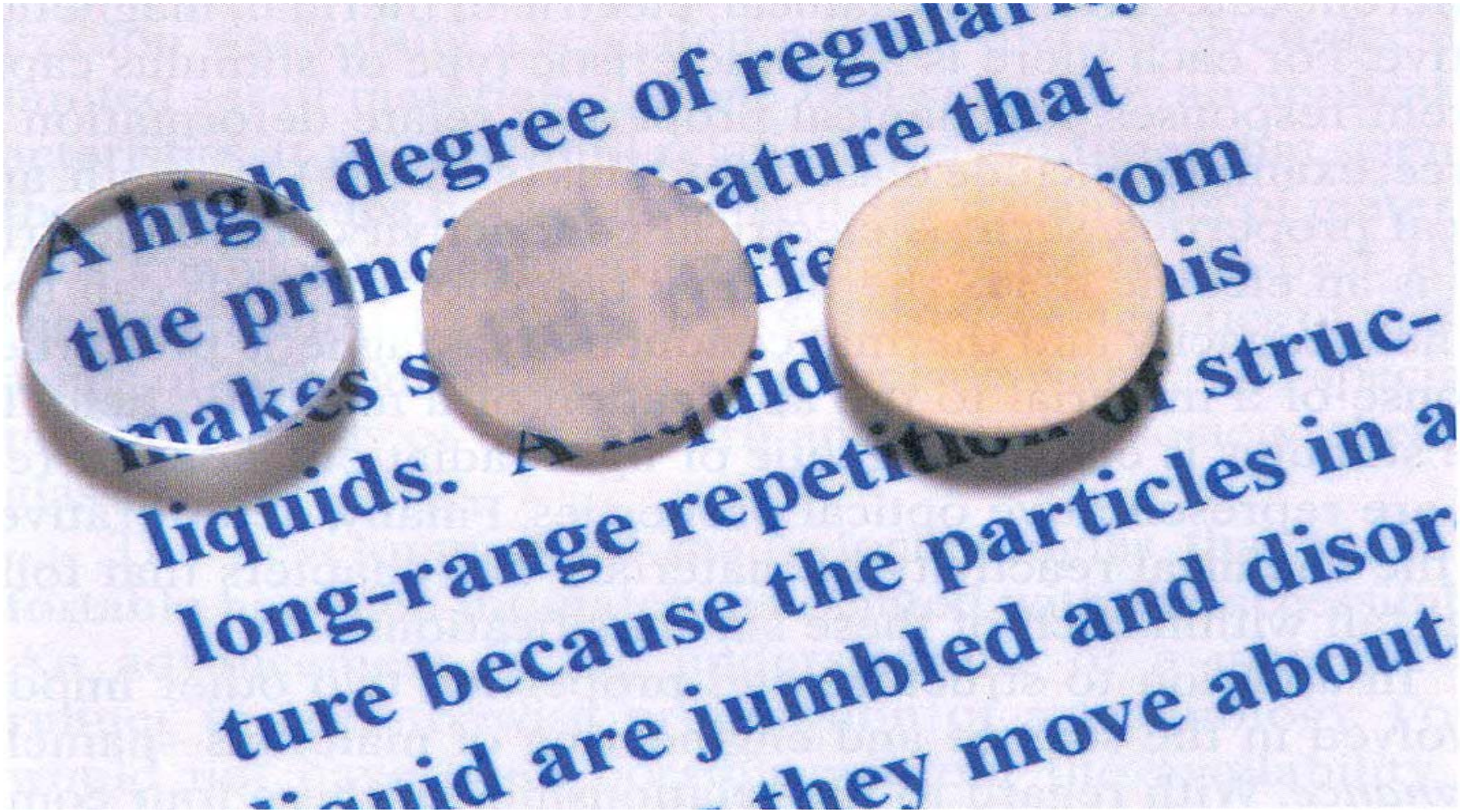

Aluminum oxide

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1.3 WHY STUDY MATERIALS SCIENCE AND ENGINEERING?

The criteria to make final decision

- In-service conditions
- Deterioration
- economics

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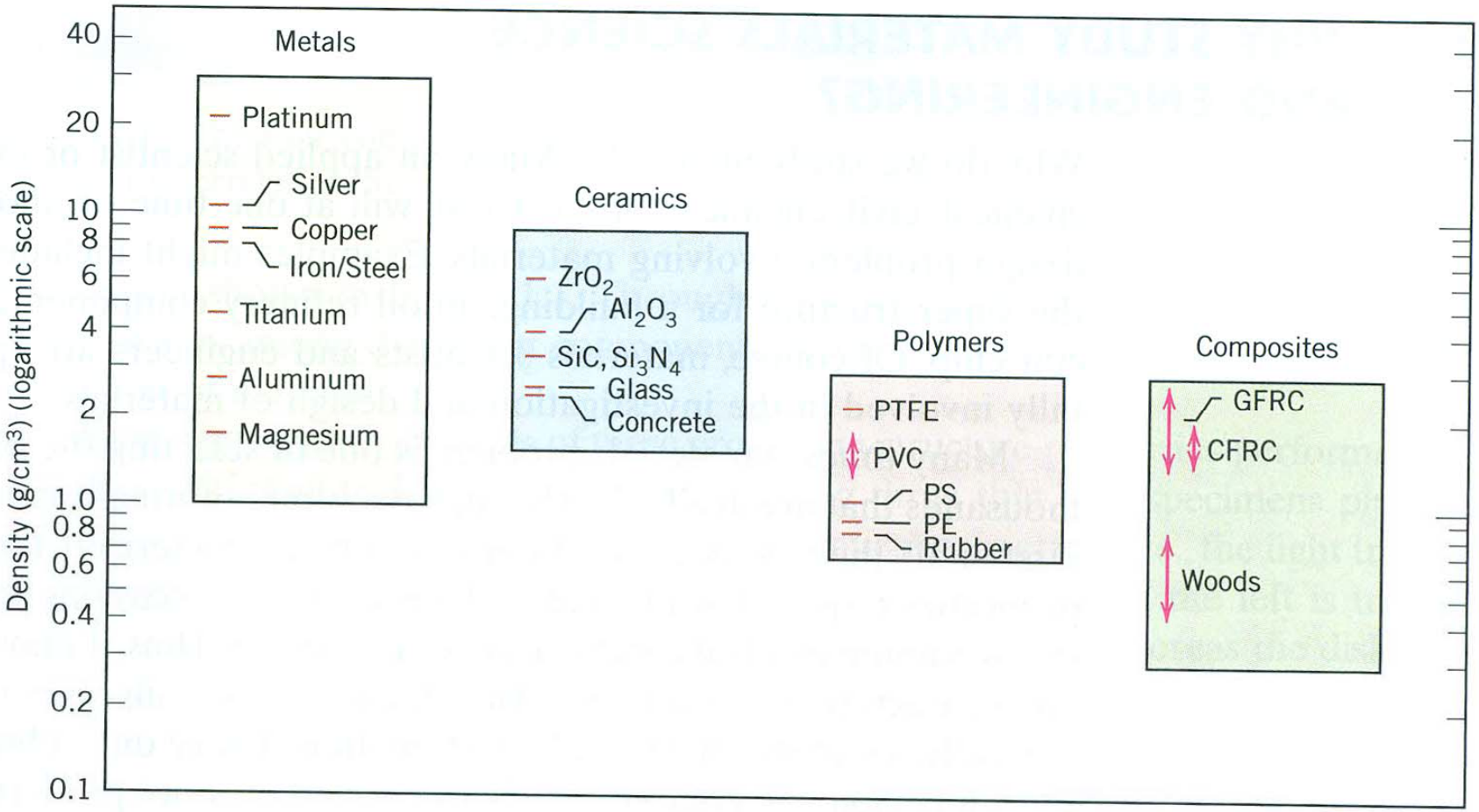
1.4 CLASSIFICATION OF MATERIALS



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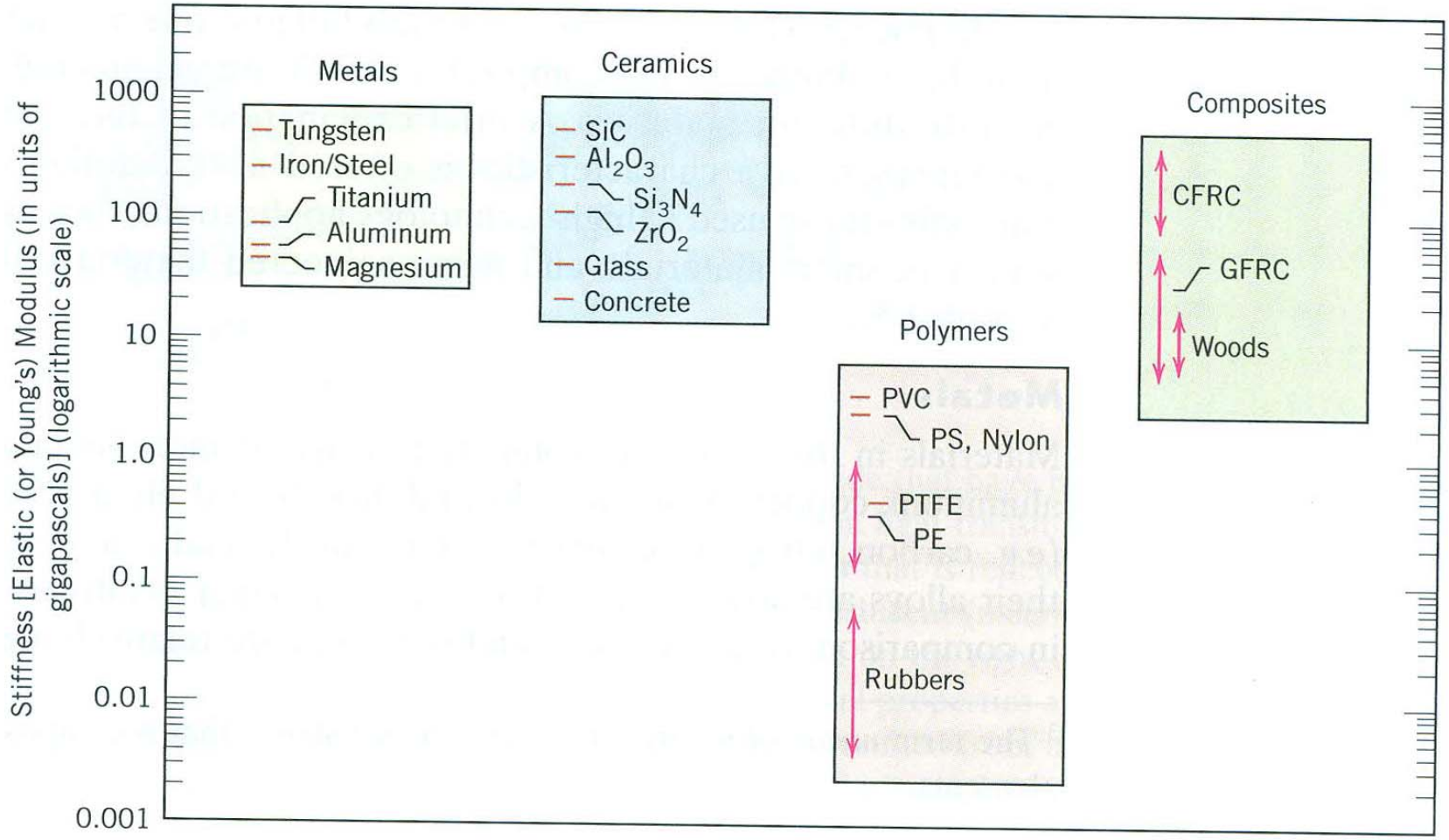

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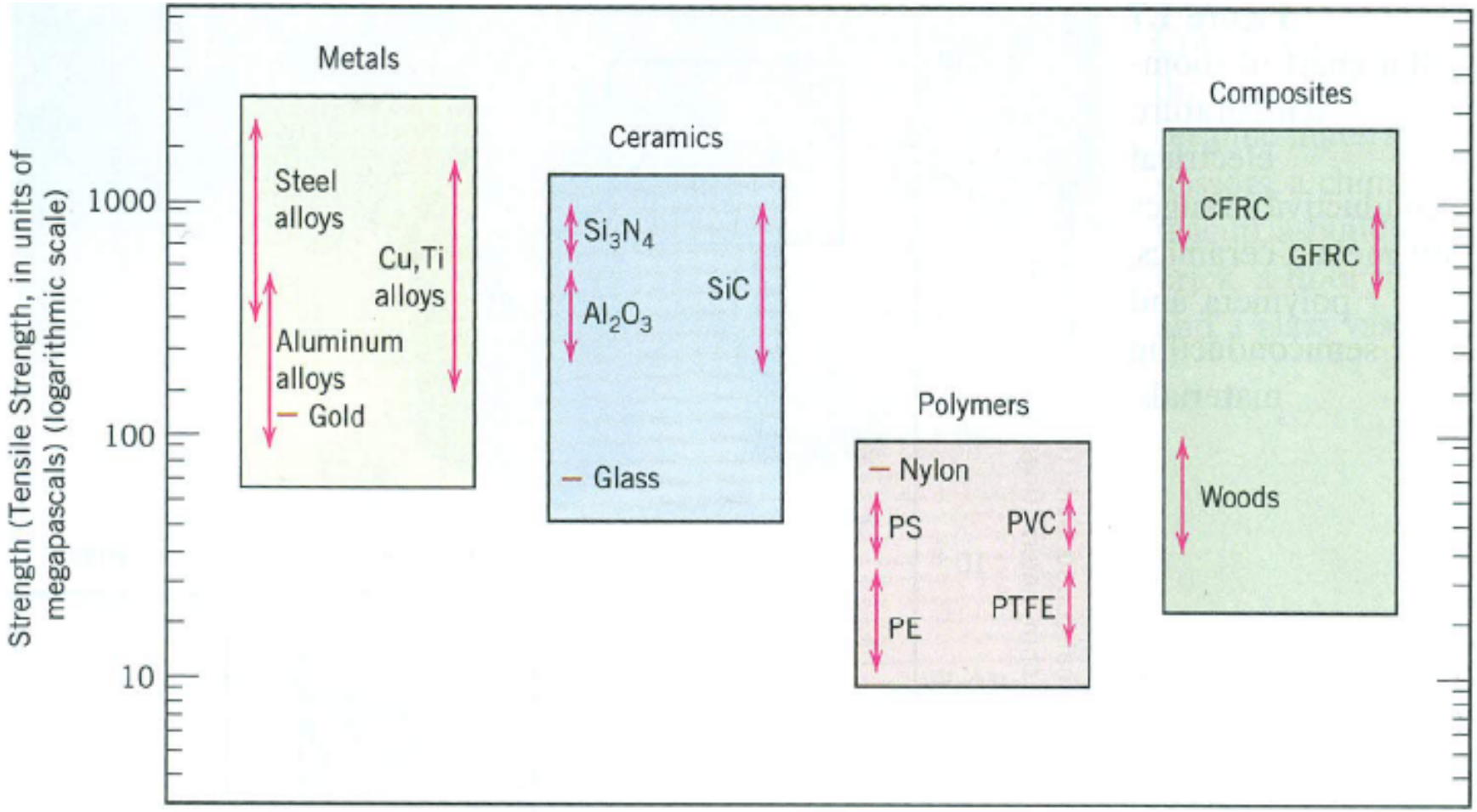

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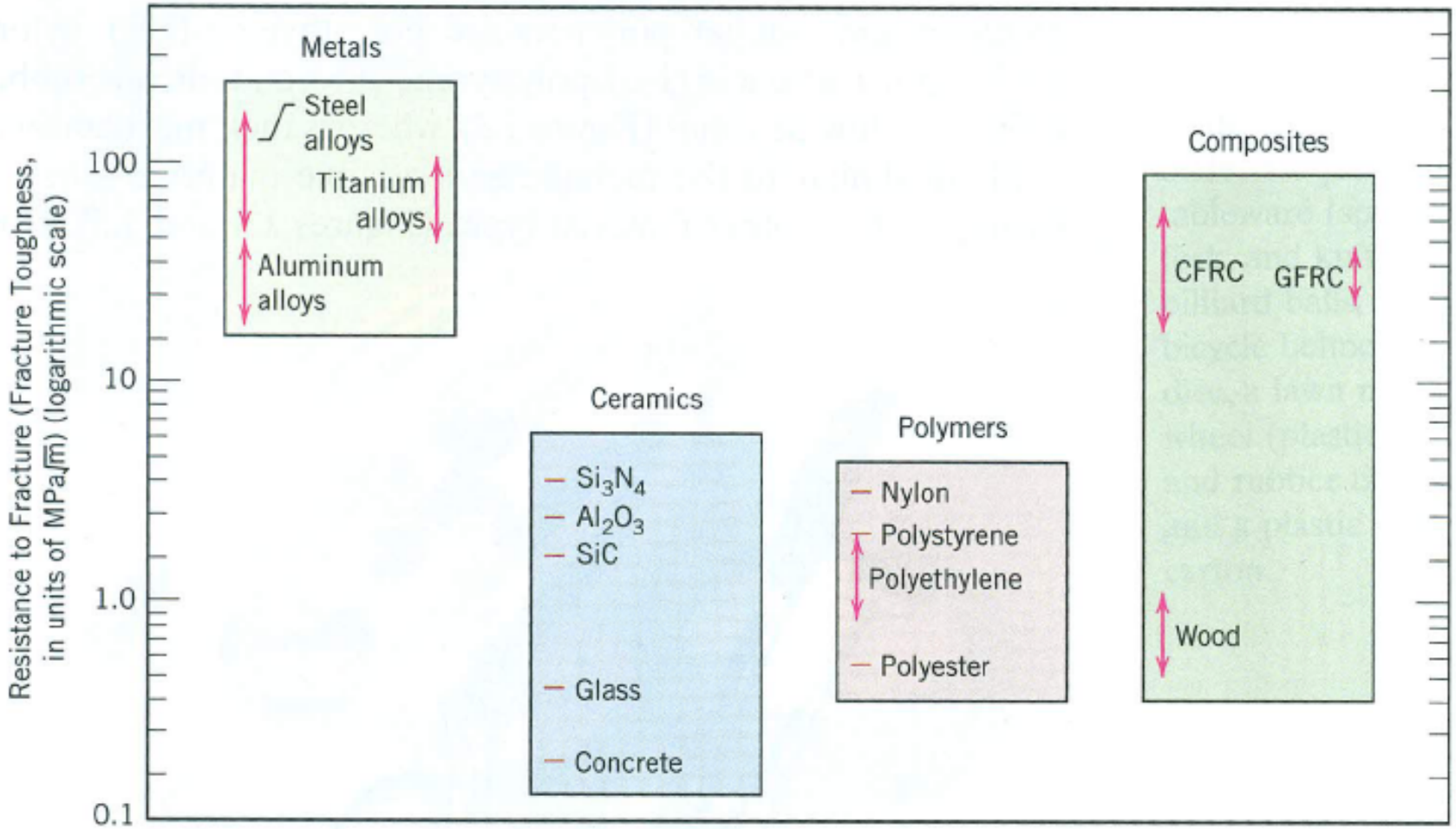

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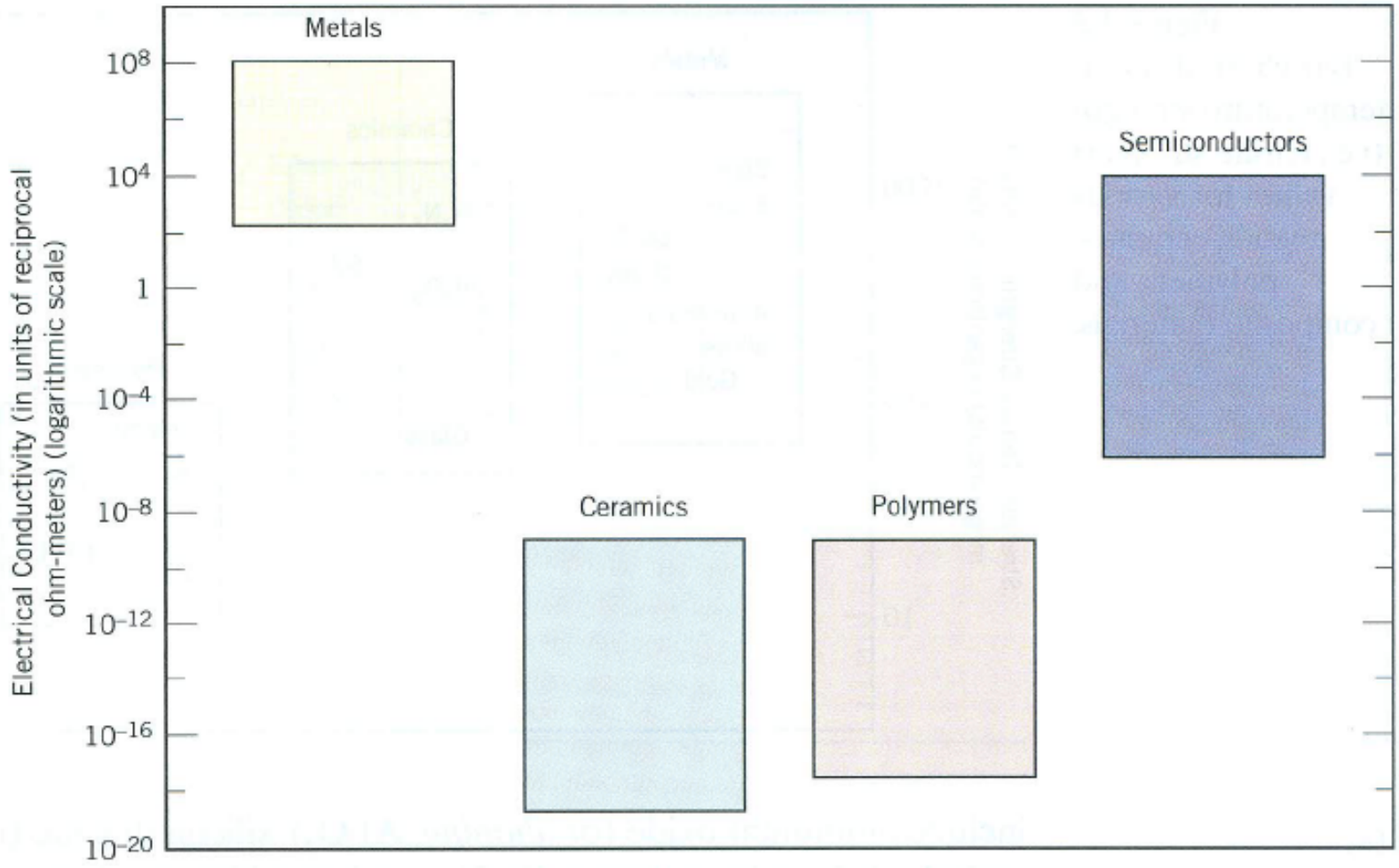

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1.4 CLASSIFICATION OF MATERIALS

- Semiconductor
- Biomaterials
- Smart materials
- nanomaterials

- Nuclear energy
- Materials of Engine
- Fuel cell
- Environmental

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QUESTION

Select one or more of the following modern items or devices and conduct an internet search in order to determine what specific material is used and what specific properties this material possess in order for the device/item to function properly, write short essay in which you report your findings:

- Cell phone
- Digital camera batteries
- Solar cells
- Wind turbine blades
- Fuel cells
- Automobile engines block (other than cast iron)
- Automobile bodies (other than steel alloys)
- Space telescope mirrors
- Military body armor
- Sports equipment