COMPOSITE MATERIALS

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Anticipated Learning Outcomes

This lecture gives an ability to identify the properties of reinforcements and matrix materials used in composites, as well as types and design of composite materials, most common manufacturing techniques, advantages and limitations, properties of composite materials and typical application areas.

CONTENT

Course Content:	
1. Week	Introduction to composite materials. General properties of ceramic, metal and polymer materials. Definitions (matrix, reinforcement, interface, etc.). Classification of composite materials.
2. Week	Introduction to reinforcements (particles, fibers, whiskers, etc.). Properties of reinforcements.
3. Week	Reinforcement-matrix interactions (particles, fibers, whiskers, etc.). Fabrication of reinforcements.
4. Week	Ceramic matrix composites. Processing, properties and applications.
5. Week	Ceramic matrix composites. Processing, properties and applications.
6. Week	I. Midterm Exam
7. Week	Metal matrix composites. Processing, properties and applications.
8. Week	Metal matrix composites. Processing, properties and applications.
9. Week	Polymer matrix composites. Processing, properties and applications.
10. Week	Polymer matrix composites. Processing, properties and applications.
11. Week	
12. Week	Mechanical properties of composite materials.
13. Week	Mechanical properties of composite materials.
14. Week	Characterisation of composite materials via destructive and non-destructive techniques. Future trends in composite materials research, production and applications.

ISSUES TO ADDRESS

- Introduction to Composite Materials
- History of composites
- Advantages and limitations of composites

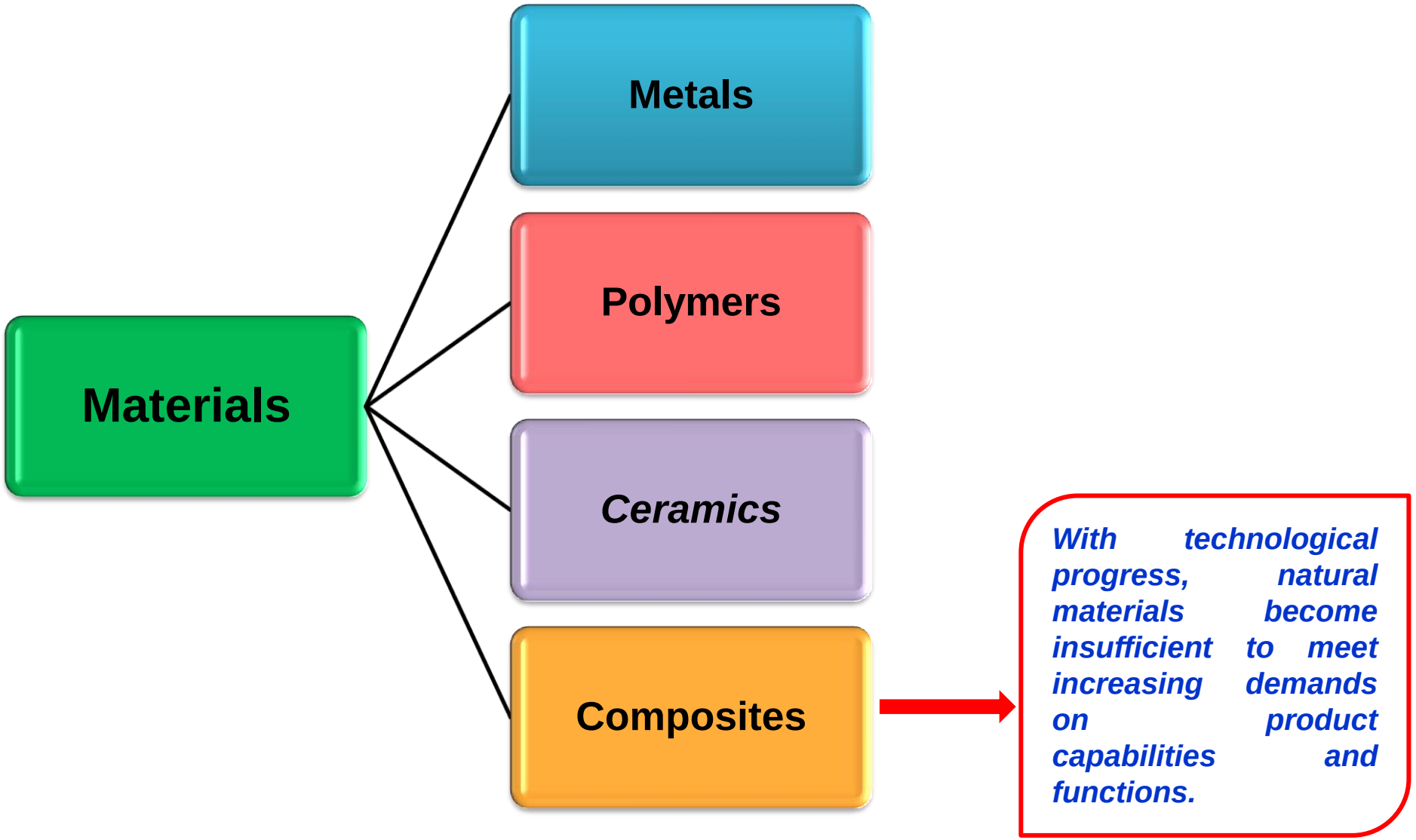
REFERENCES

- Krishnan K. Chawla, “Composite Materials Science and Engineering”, Springer, 2001.
- Matthews, F.L. and R.D. Rawlings, 1999, Composite Materials: Engineering and Science, Woodhead Publishing.
- Handbook of Composites, American Society of Metals, 1990.
- Derek Hull, “Introduction to Composite Materials”, Cambridge University Press, 1988.

ISSUES TO ADDRESS

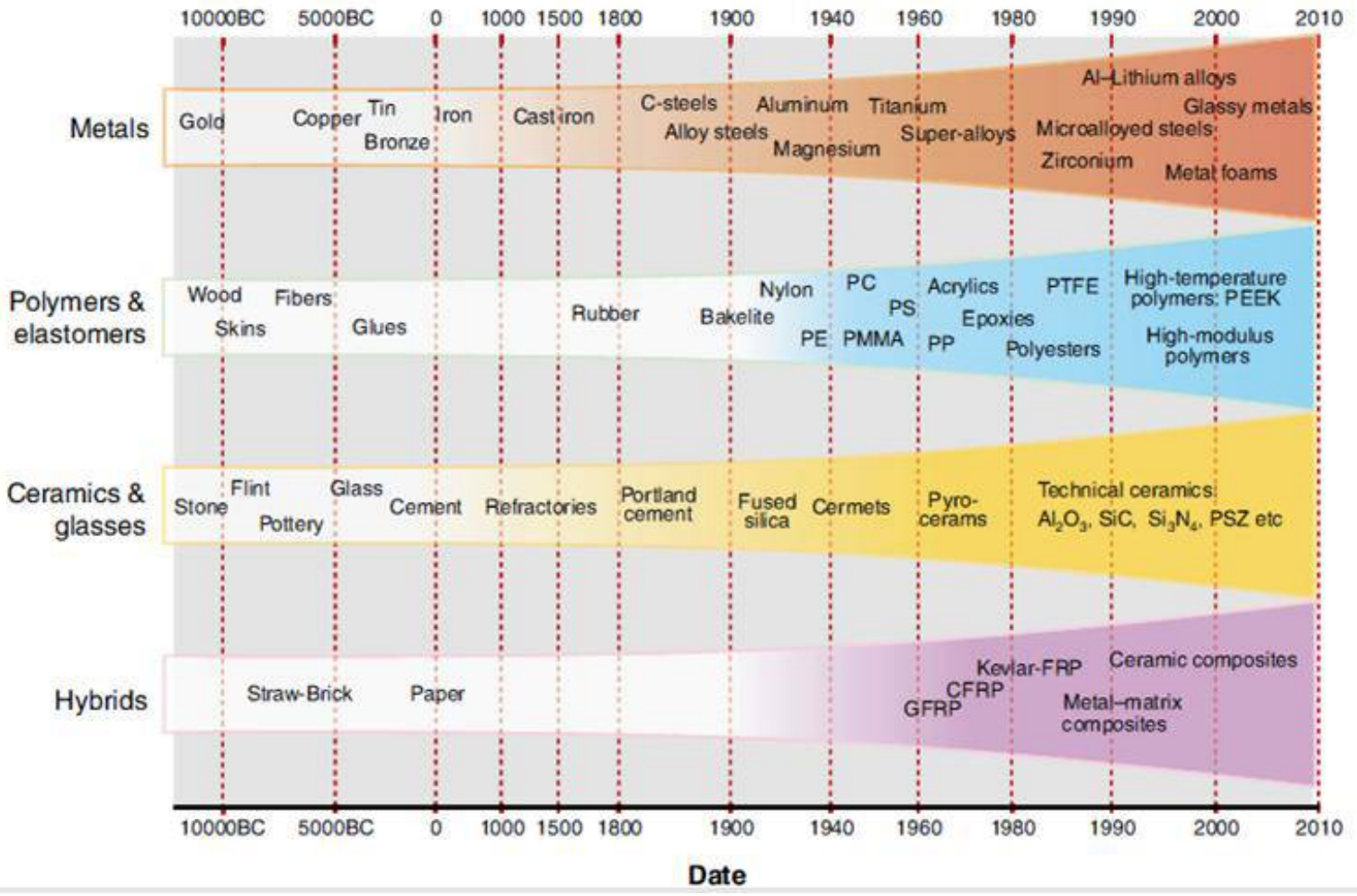
- What is composite?
- Why are composites used instead of metals/ceramics or polymers?
- What are the classes and types of composites?
- What are the typical applications of composite materials?

COMPOSITE MATERIALS



COMPOSITE MATERIALS

The development of materials over time



The materials of pre-history, on the left, all occur naturally; the challenge for the engineers of that era was one of shaping them. The development of thermochemistry and (later) of polymer chemistry enabled man-made materials, shown in the colored zones. Three—stone, bronze and iron—were of such importance that the era of their dominance is named after them.

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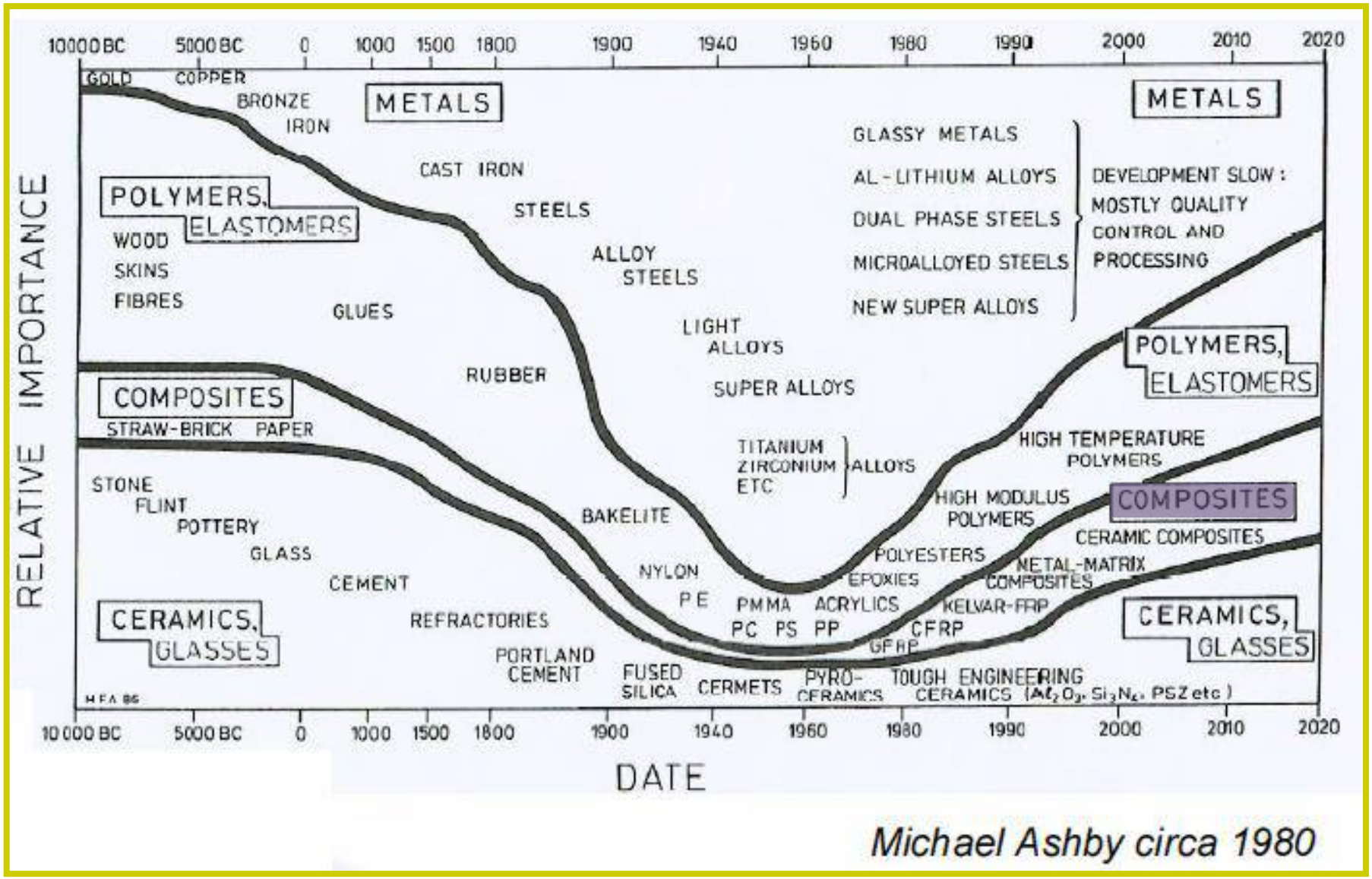

Michael Ashby circa 1980

COMPOSITE MATERIALS

Historical Perspective

- Used in ancient Egypt, Americas, and China
  - Straw was used to reinforce bricks
- Many natural materials are composites
  - Wood, grasses, bones, bee hives, bird nests, deer antlers, etc.