

5- Epilogo.

- Gli sviluppi più recenti

Evoluzione delle tecnologie e dei materiali

Acciai inossidabili

Leghe leggere

Superleghe

Ceramici avanzati

Materiali compositi

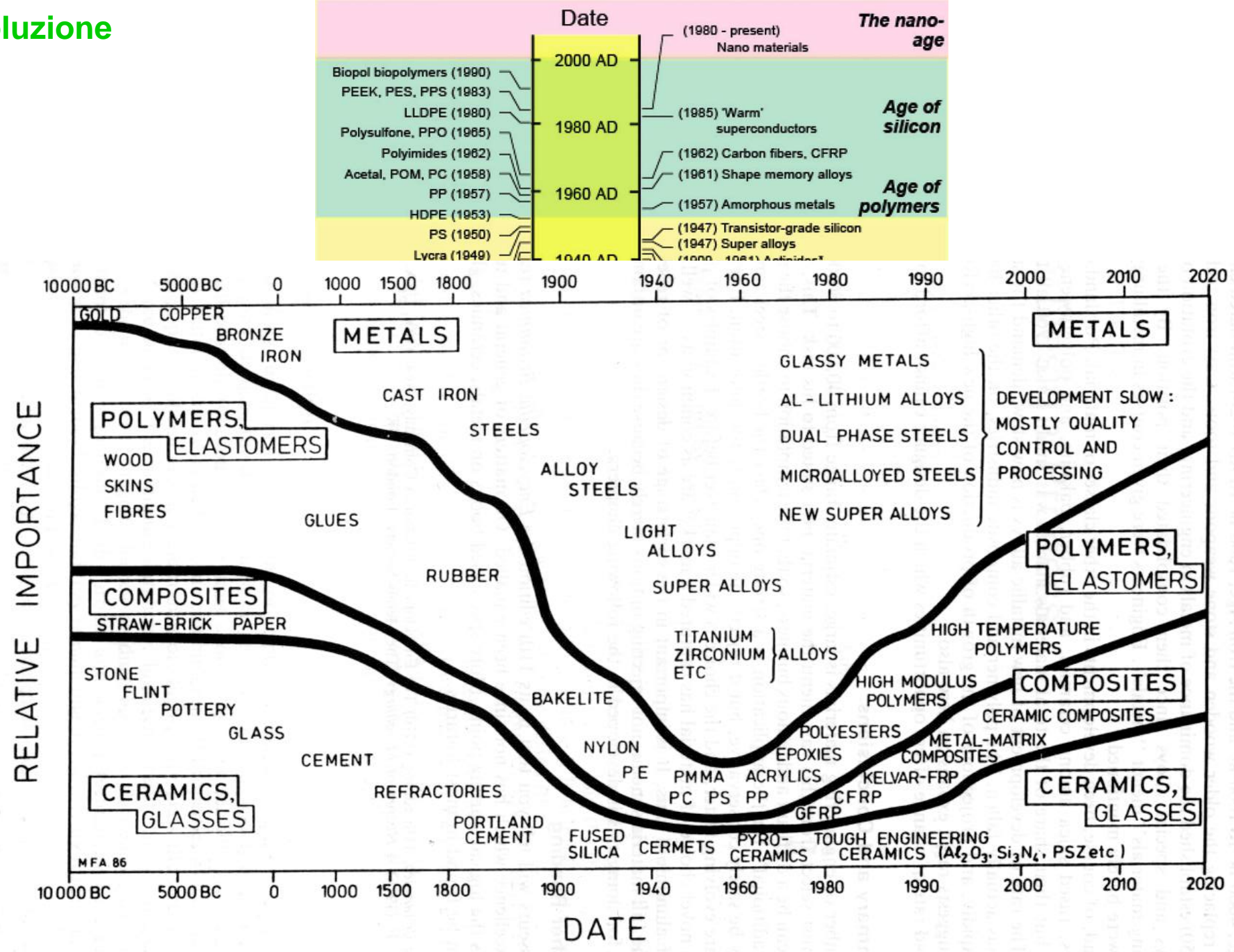
- Prospettive future

Le spinte del progresso

... l'età dell'energia (!?)

- Fine

Evoluzione

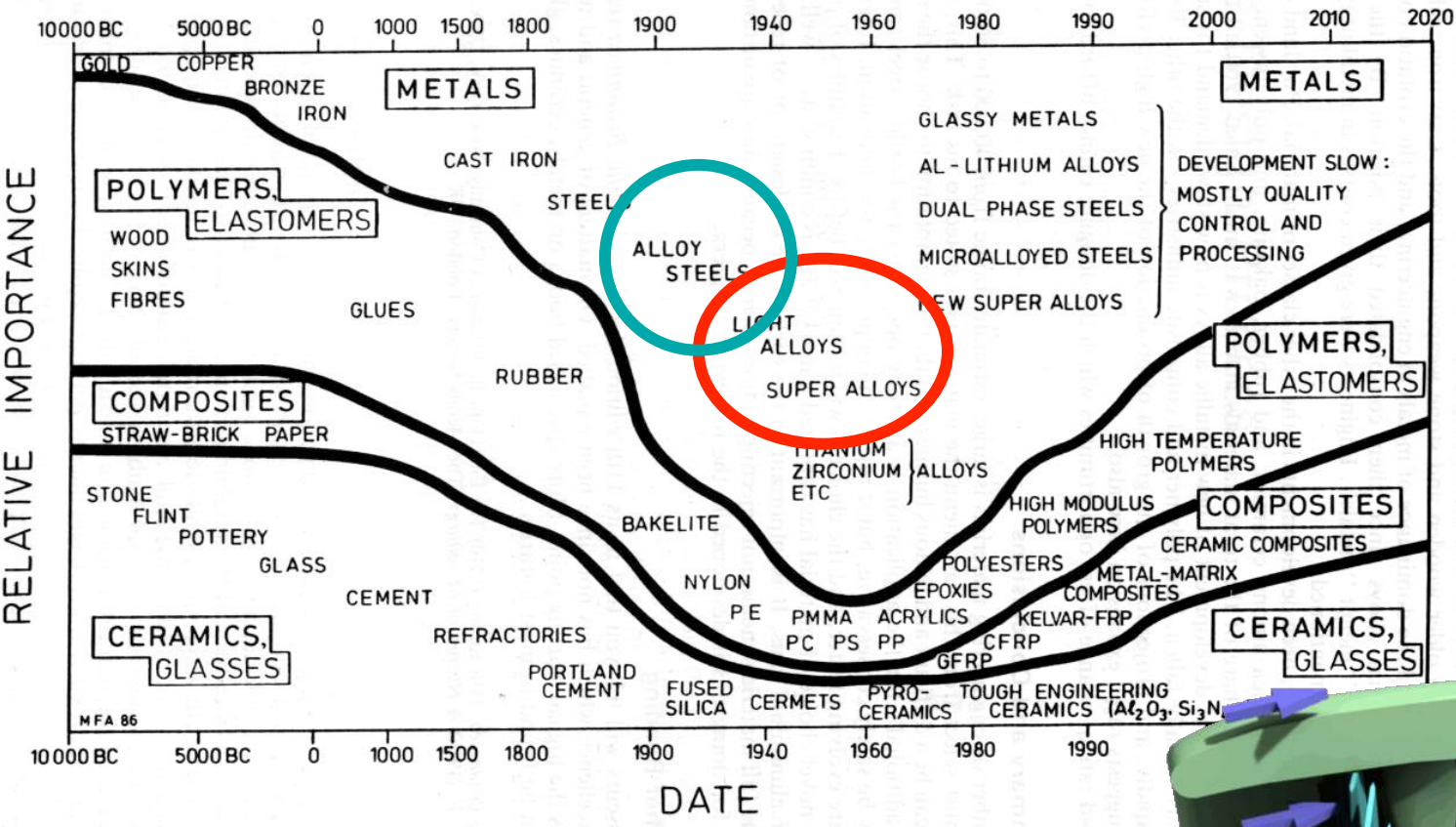


Date	Material	Age
100,000 BC	Stone, flint (prehistory)	Stone age
7000 BC	Native copper	
20,000 BC?	Gold	Stone age
1940-1980	Rubber, Bakelite, Nylon, PE, PMMA, Acrylics, PC, PS, PP, GFRP	
1947	Transistor-grade silicon, Super alloys	Age of silicon
1957	Amorphous metals	
1961	Shape memory alloys	Age of silicon
1962	Carbon fibers, CFRP	
1985	'Warm' superconductors	Age of silicon
1980 - present	Nano materials	
1990	Biopol biopolymers	The nano-age

Date	Material	Age
100,000 BC	Wood (prehistory), Stone, flint (prehistory)	Stone age
7000 BC	Native copper	
20,000 BC?	Gold	Stone age

Mike Ashby, Cambridge, 2007

Evoluzione

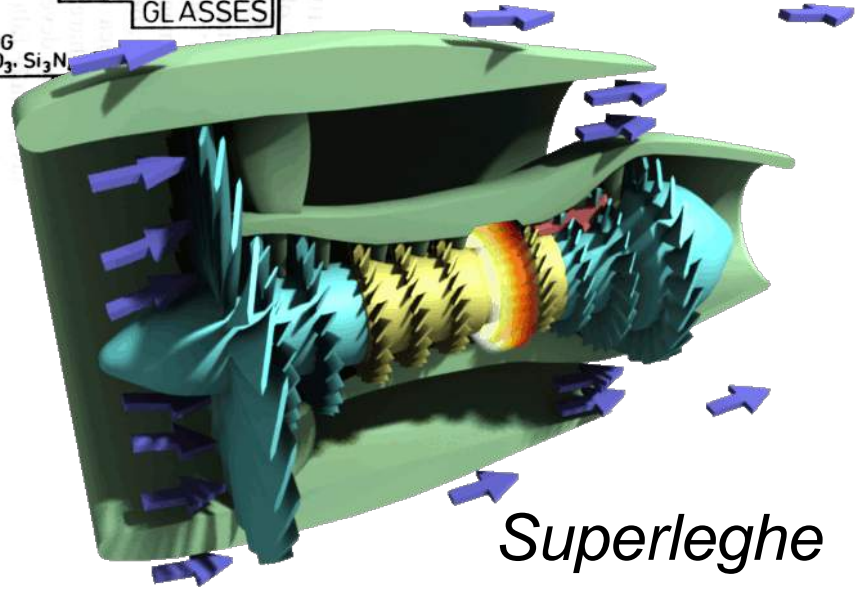


Acciai



Leghe Leggere:

- a base di Al
- a base di Ti
- a base di Mg



.... Inossidabili!

1905 : si dimostra la resistenza ad attacco acido di acciai con almeno 9% di Cr.

1912 : brevettato dalla Krupps il primo acciaio inossidabile austenitico (fcc) contenente 20% Cr e 5% Ni



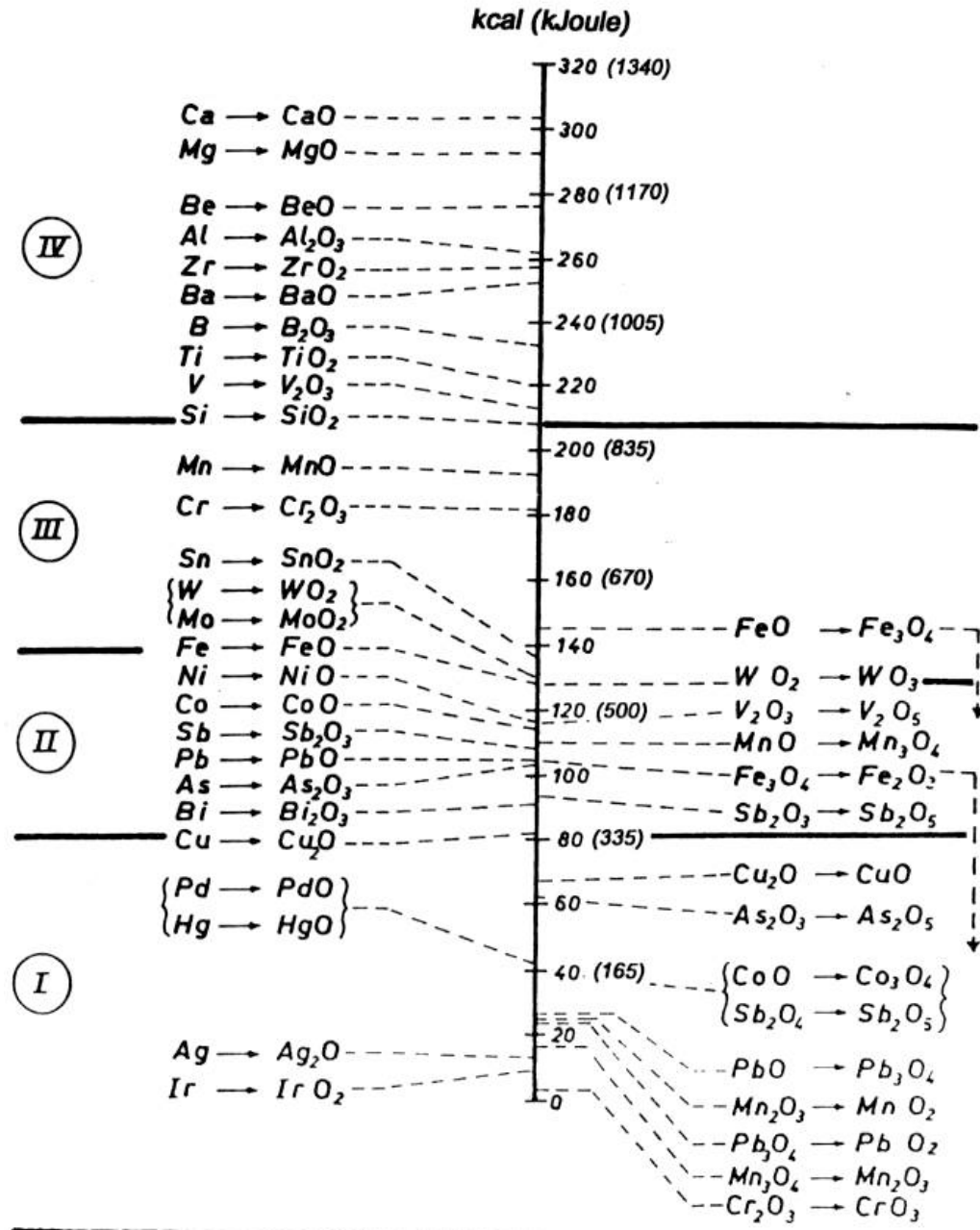
Leghe Leggere: base Al, Mg e Ti

1886 : Hall (USA) e Heroult (Francia) mettono a punto il processo estrattivo dell'alluminio, per via elettrolitica.

1940 : Kroll sviluppa il processo di estrazione del titanio a partire da $TiCl_4$.

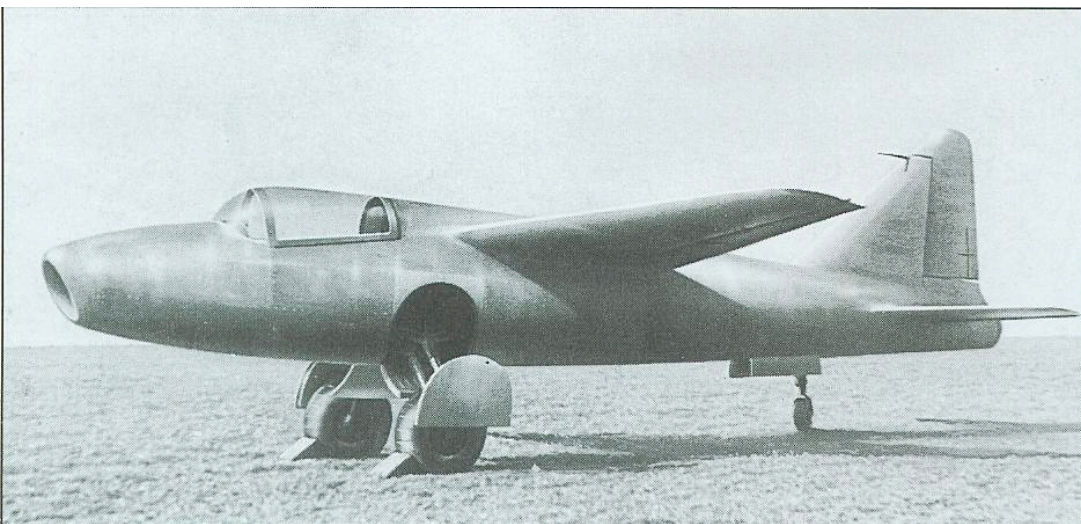
1944: Processo elettrolitico per la estrazione del magnesio.

Cosa ha **ostacolato** lo sviluppo della metallurgia delle leghe leggere sino a tempi relativamente recenti!?

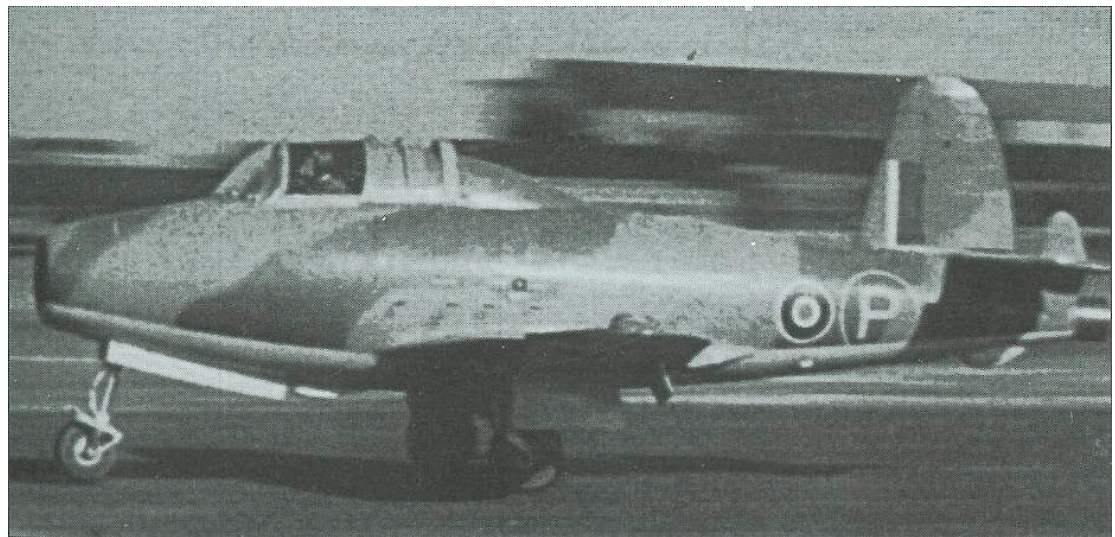


La elevata stabilità degli ossidi (materie prime) di Al, Mg e Ti!

Superleghe ... a base di nichel:

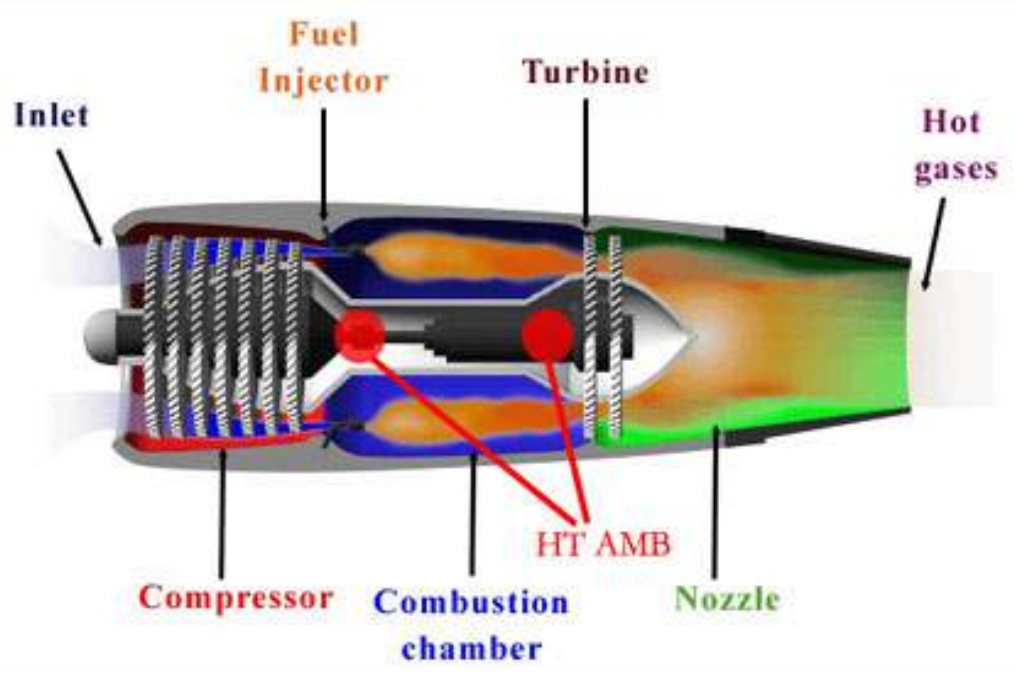
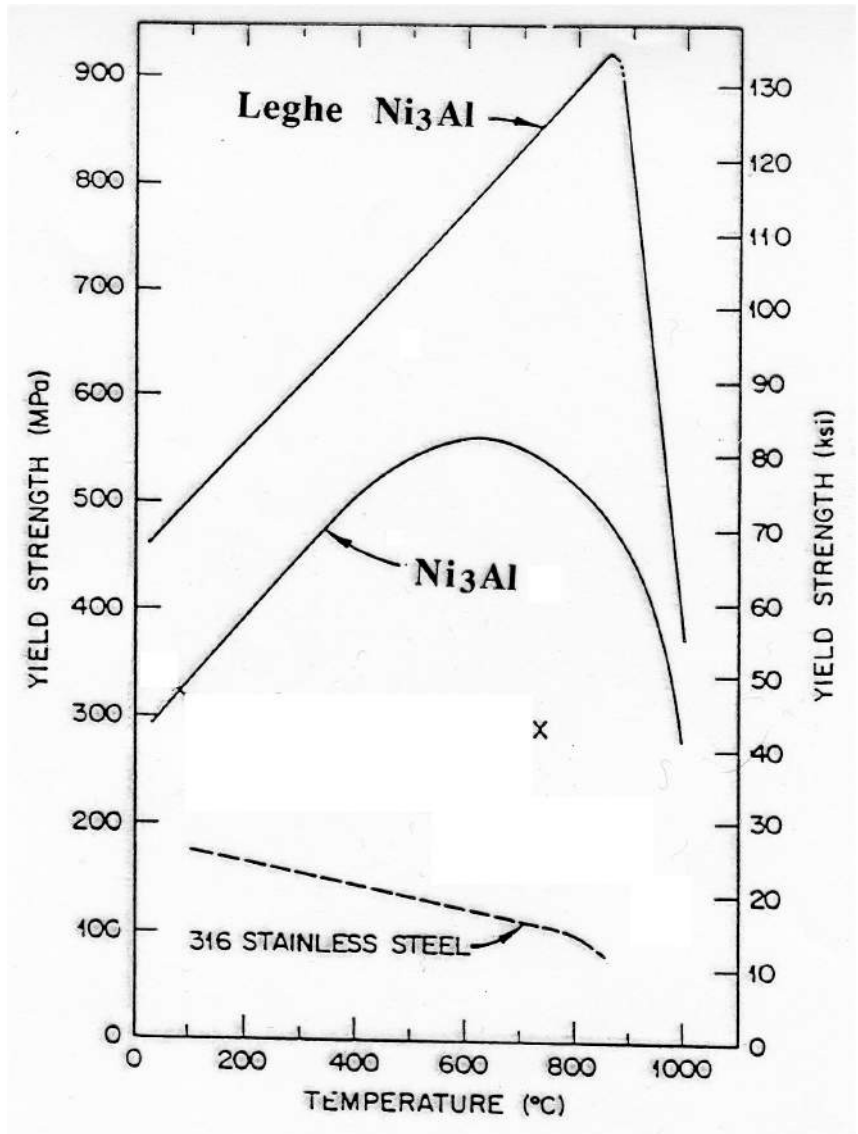


Heinkel - He178 (1939) - Germania
Motore: von Ohain

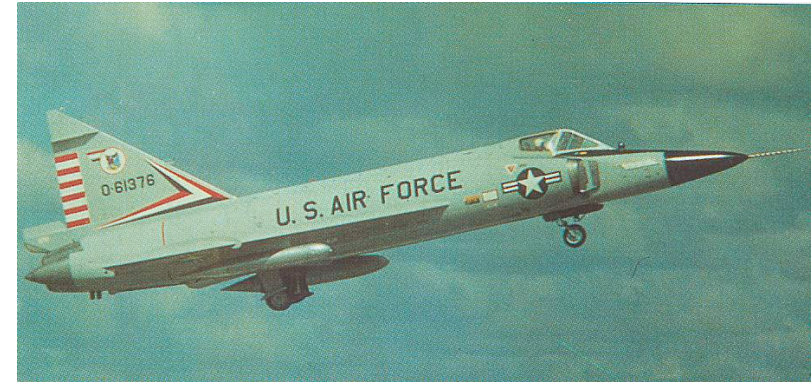
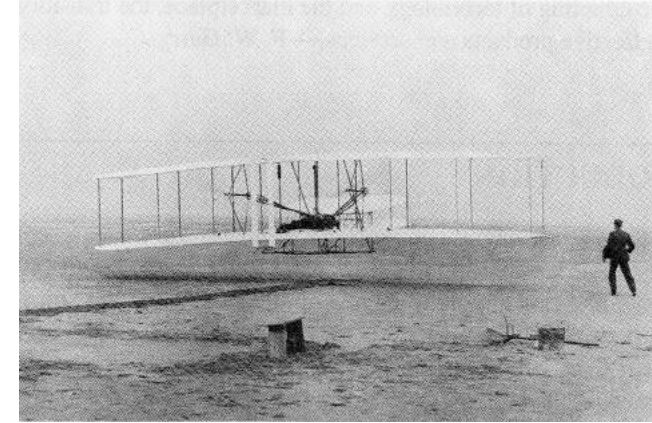
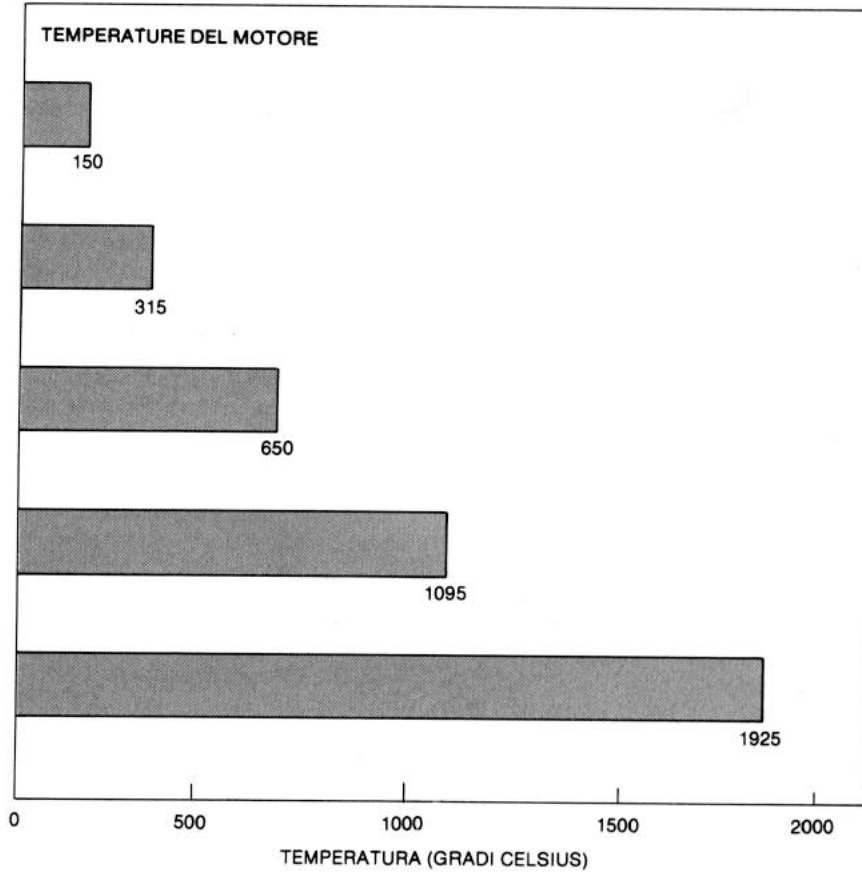
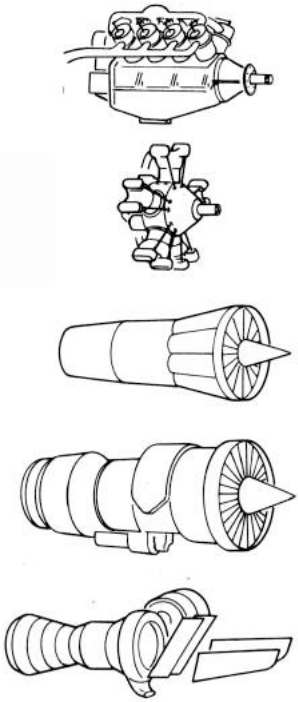


Gloster - E.28/39 (1941) - Inghilterra
Motore: Whittle

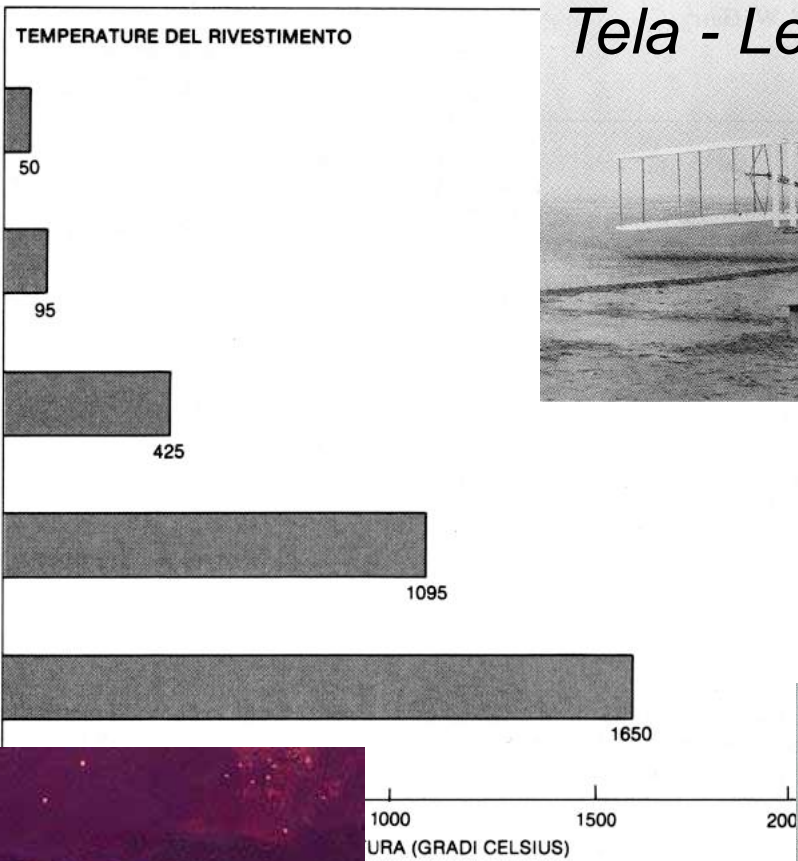
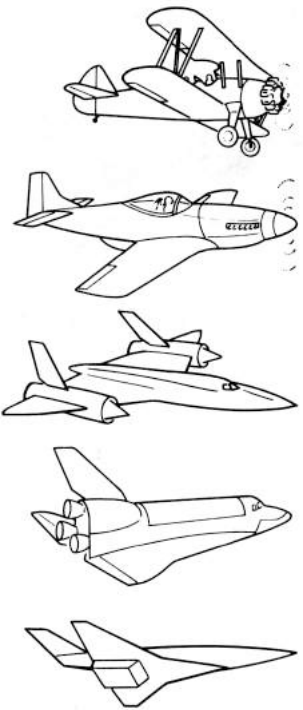
Superleghe



Superleghe



Ceramici



Tela - Legno



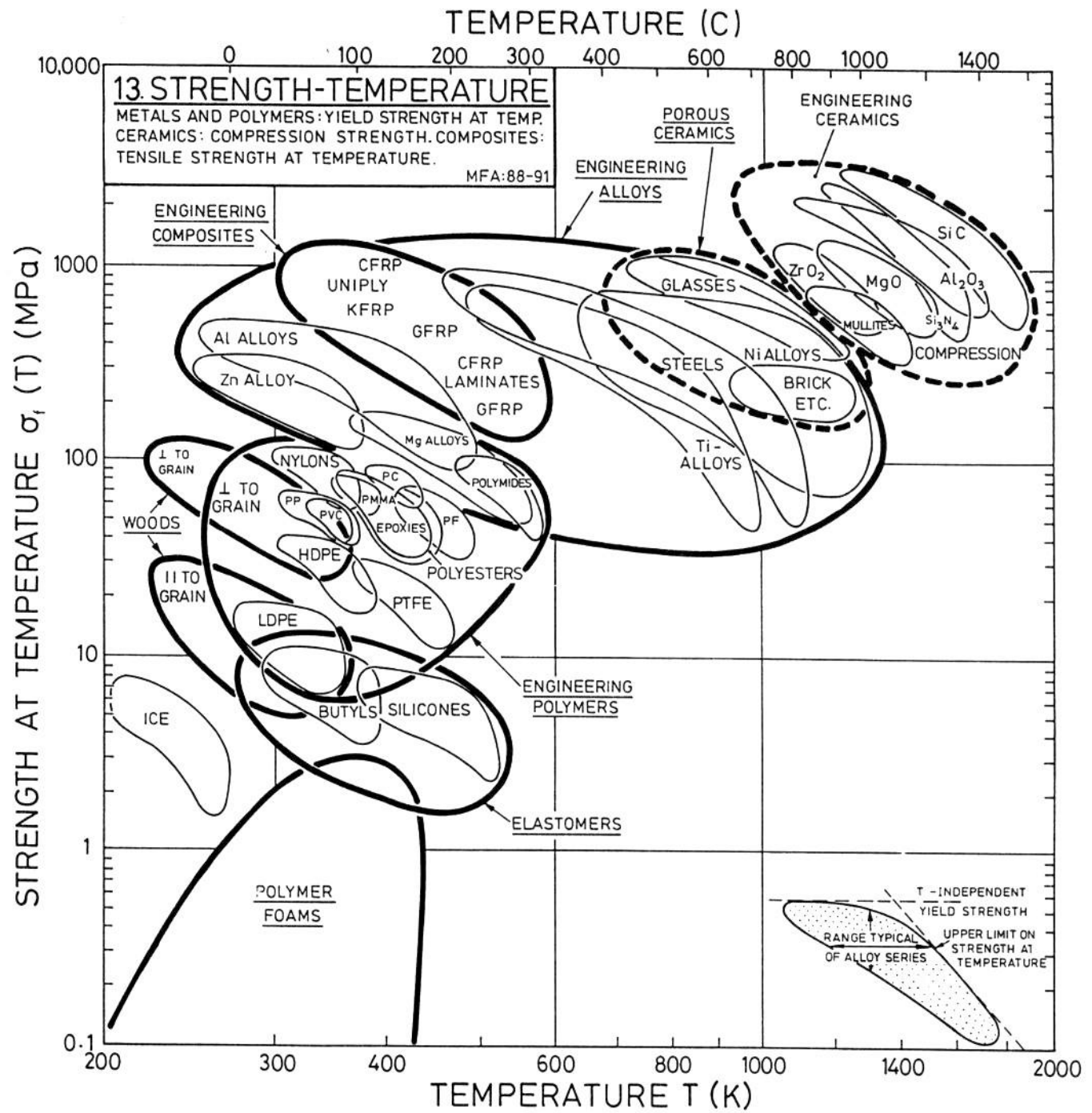
Leghe Al



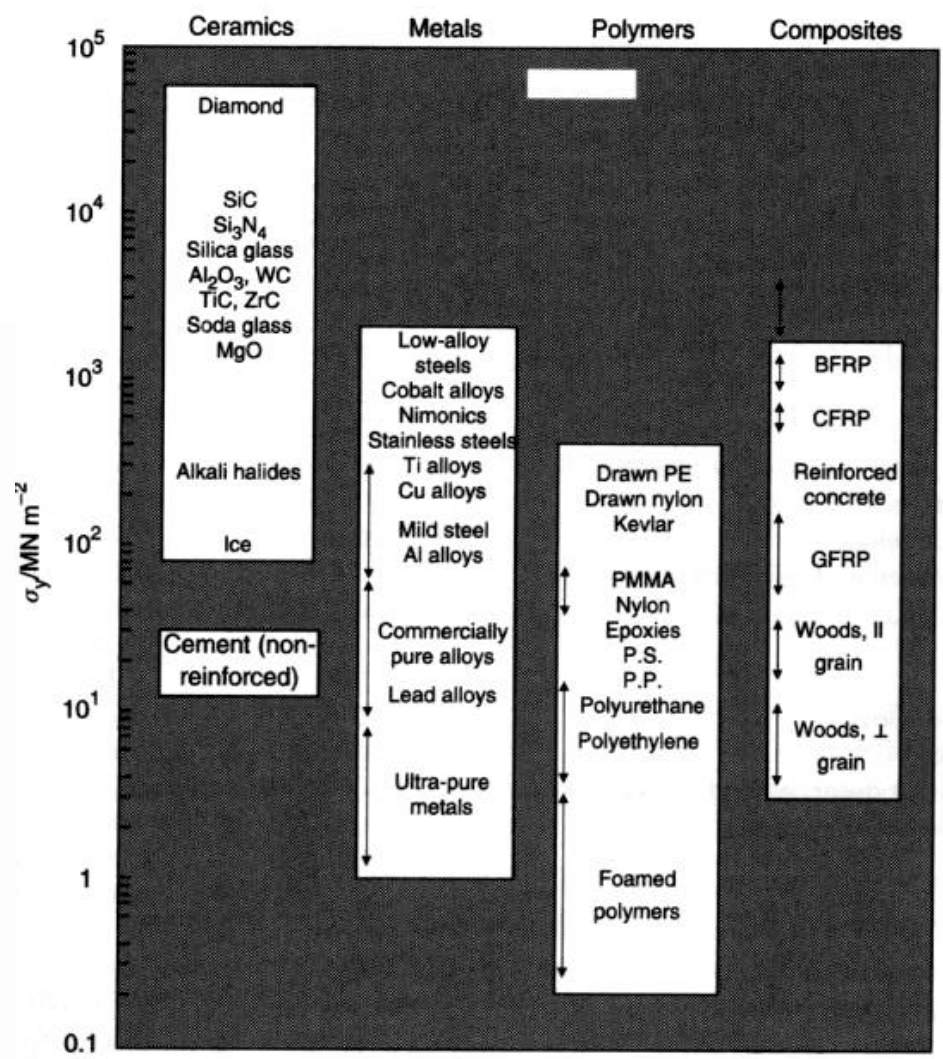
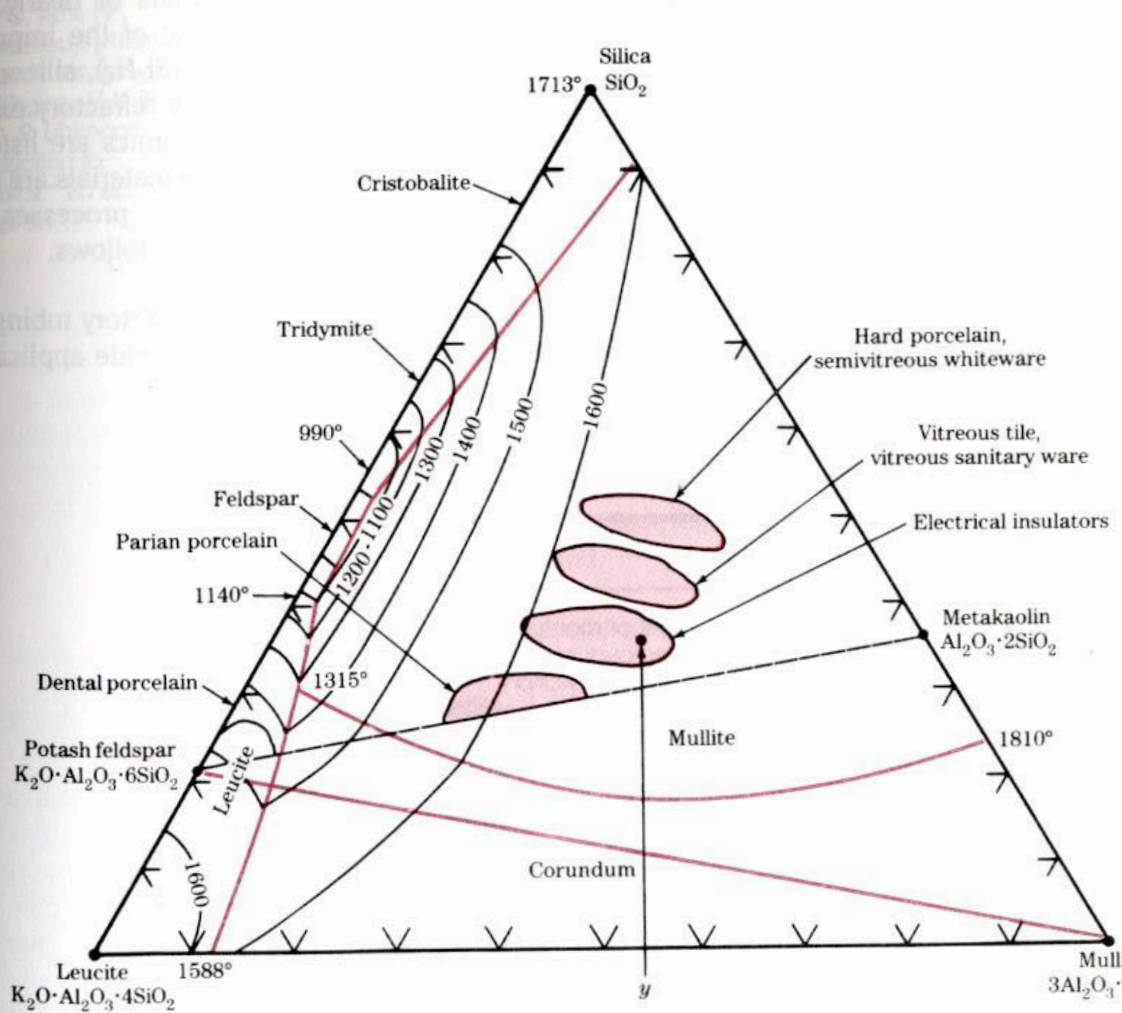
Leghe Ti



Ceramici - Compositi

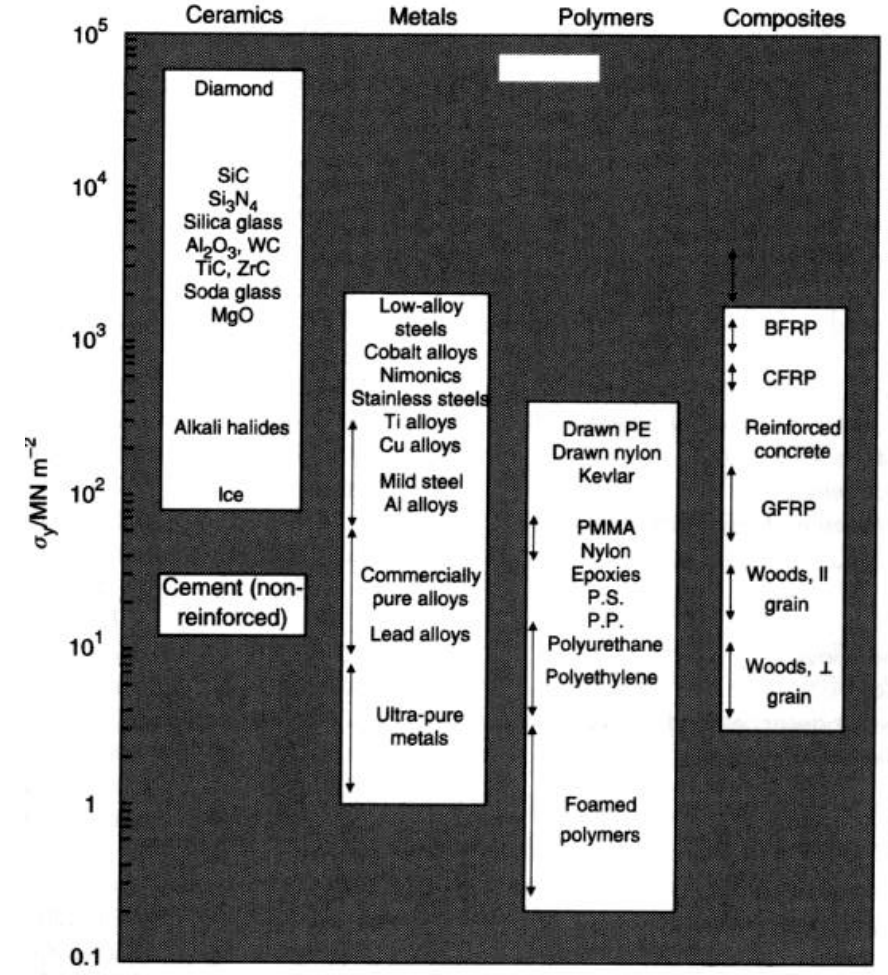
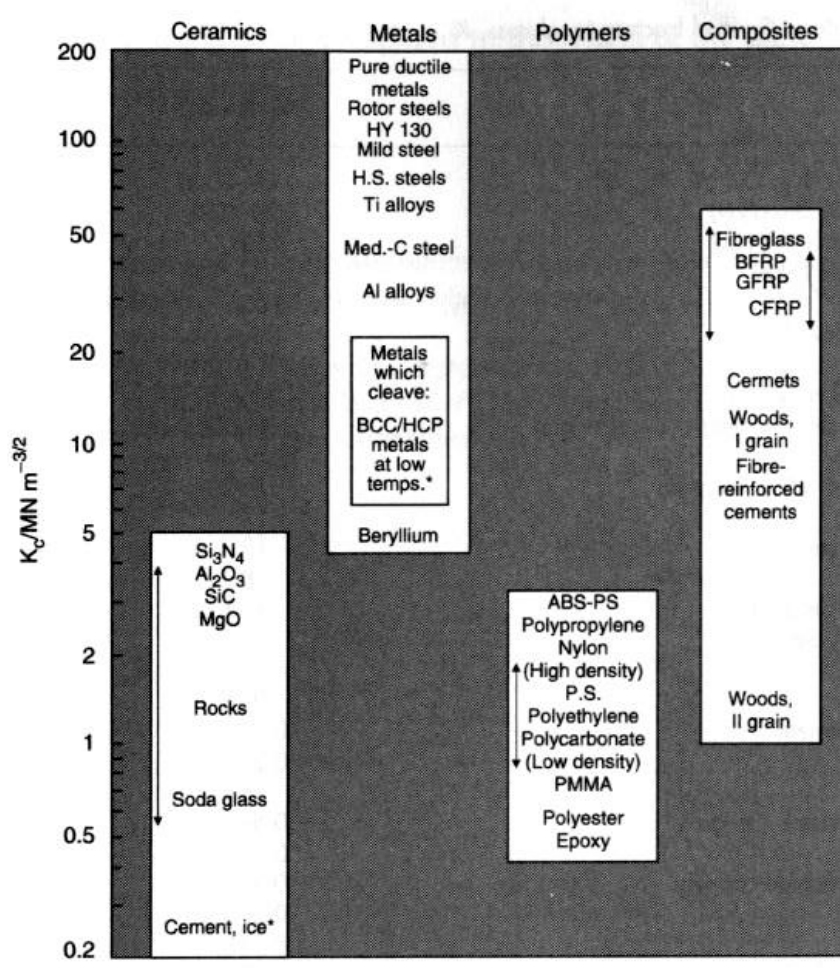


Ceramics

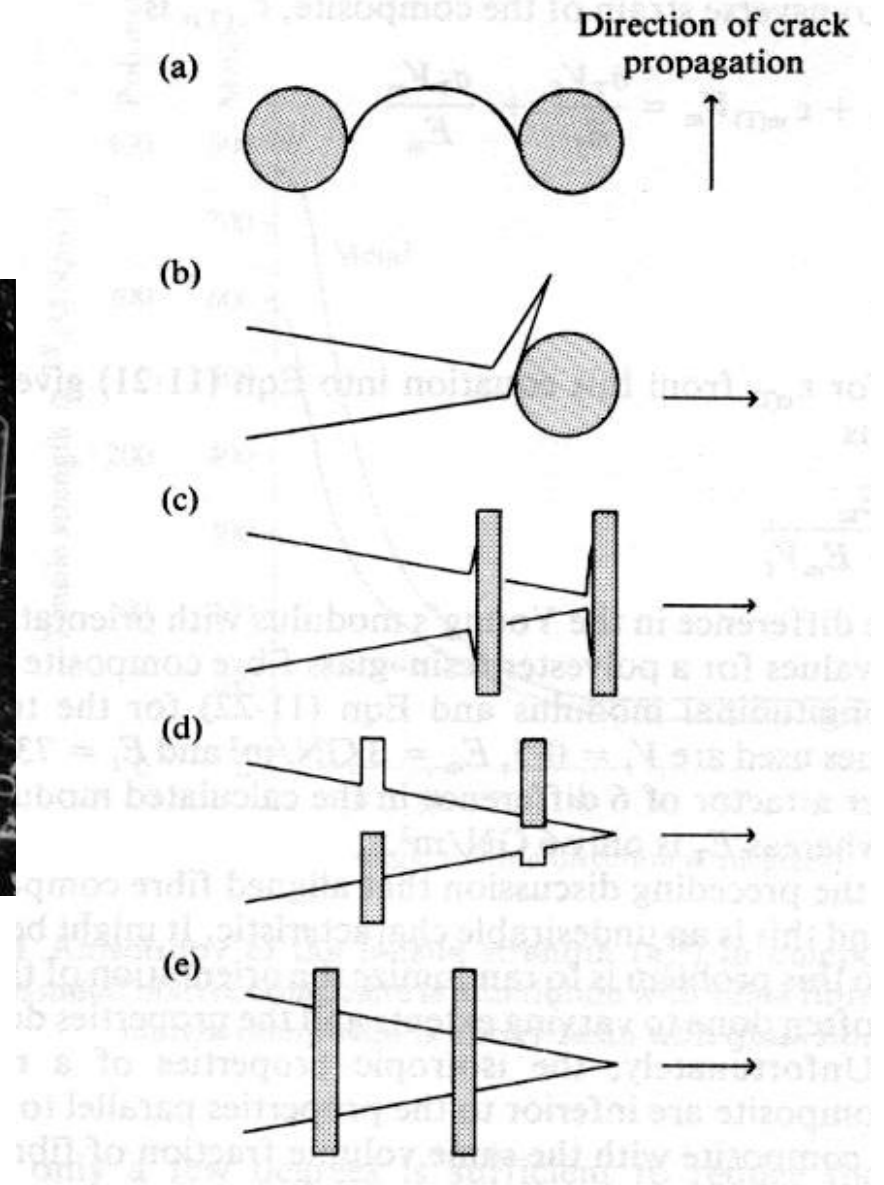
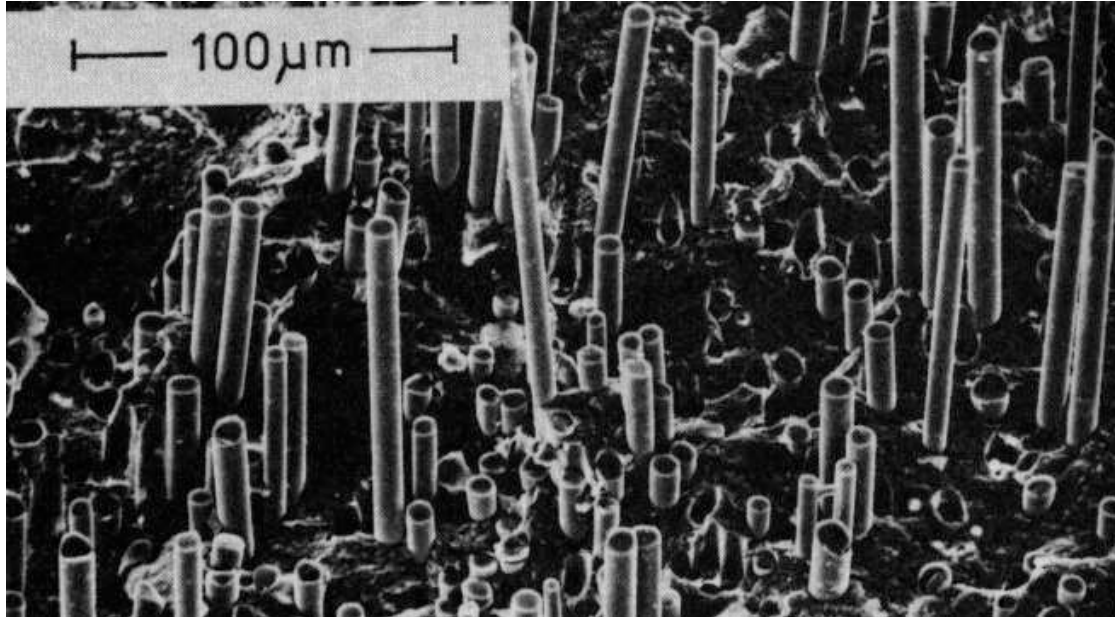


Limite di snervamento

Ceramici



*Resistenza al danneggiamento
(tenacità a frattura)*



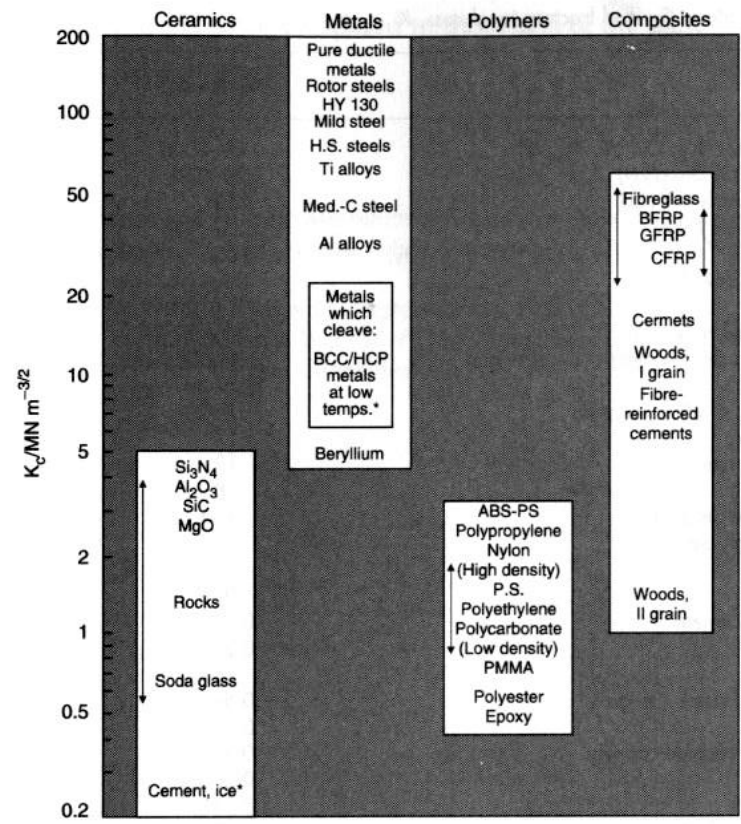
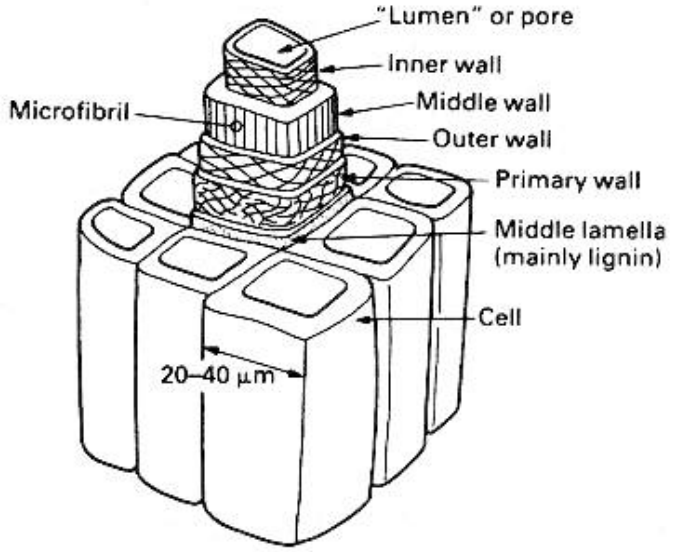
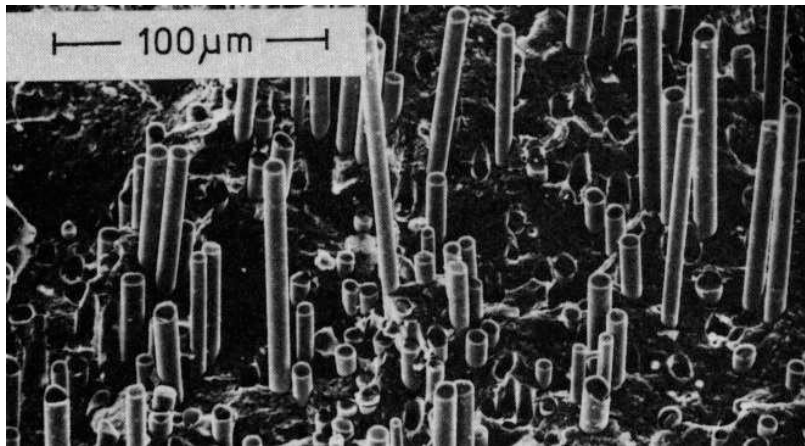
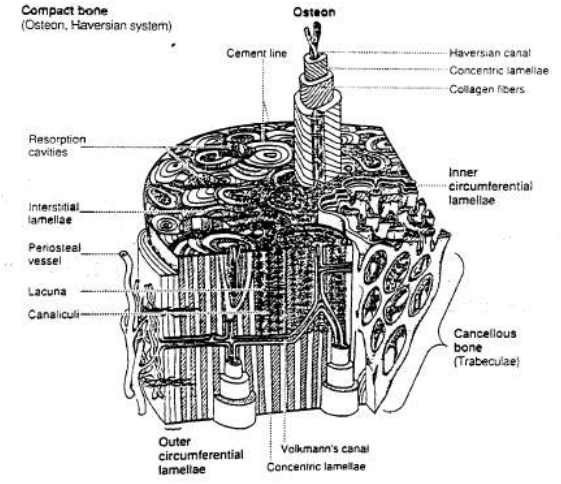
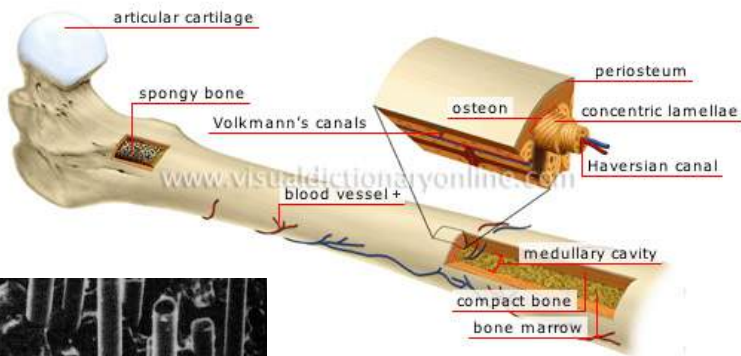
*Meccanismi di tenacizzazione
in materiali compositi*

Compositi

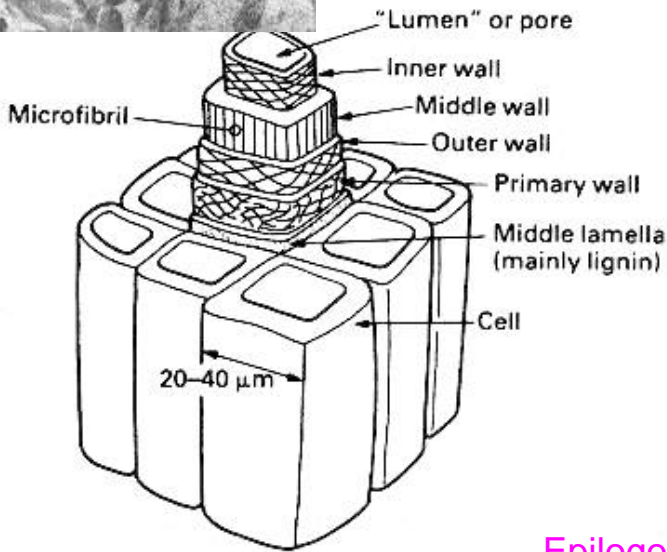
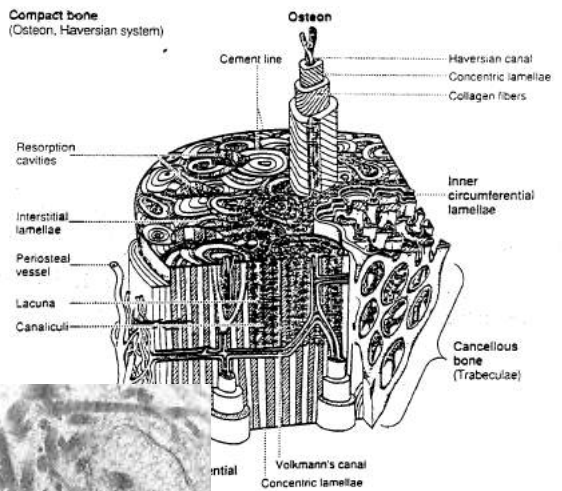
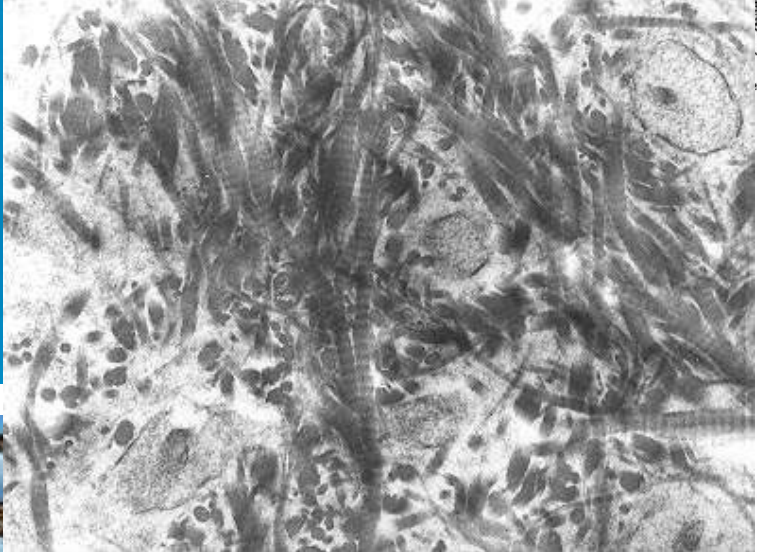


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Cross-section of a CD

Compositi



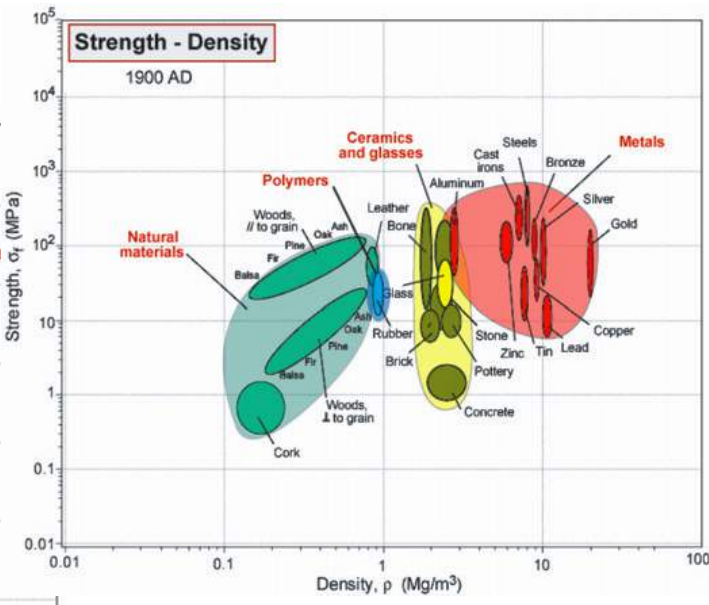
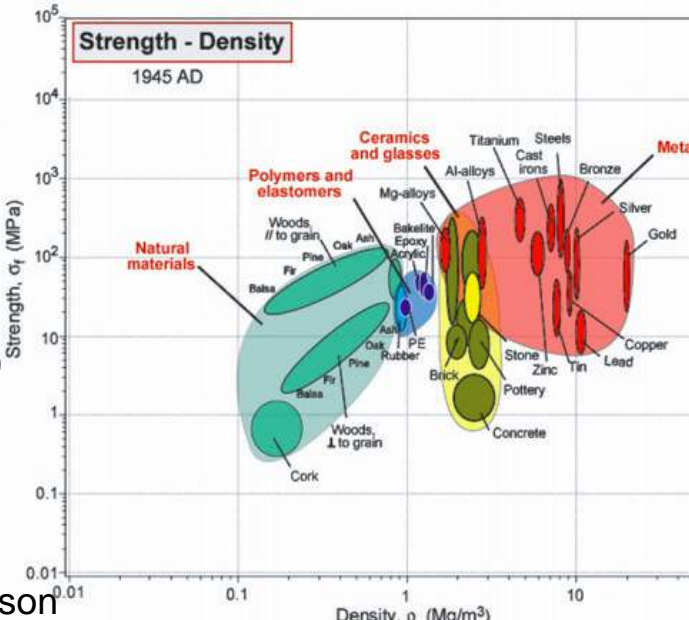
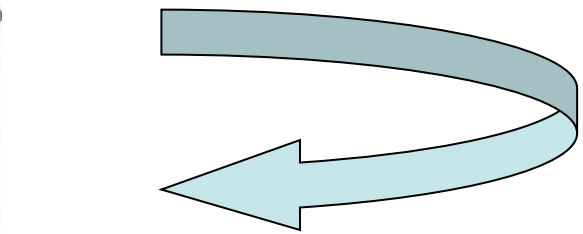
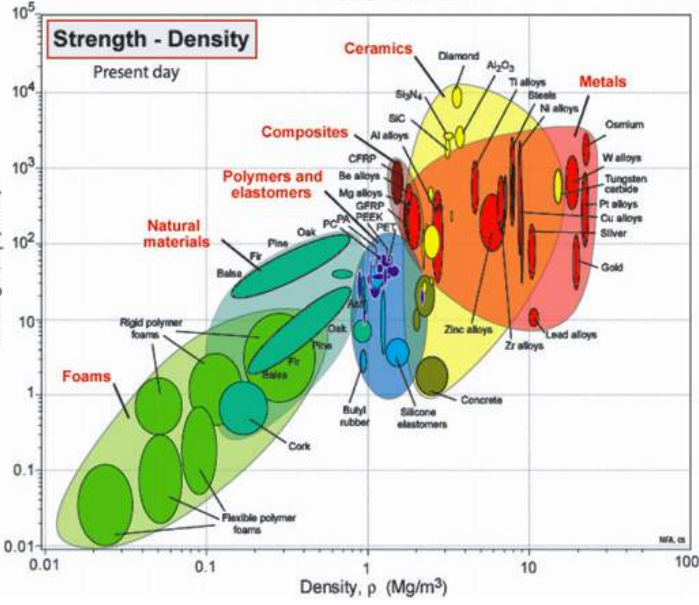
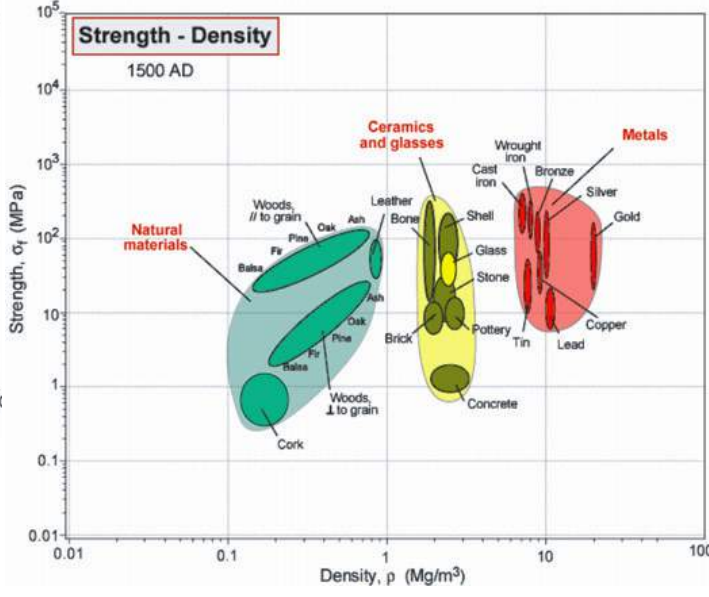
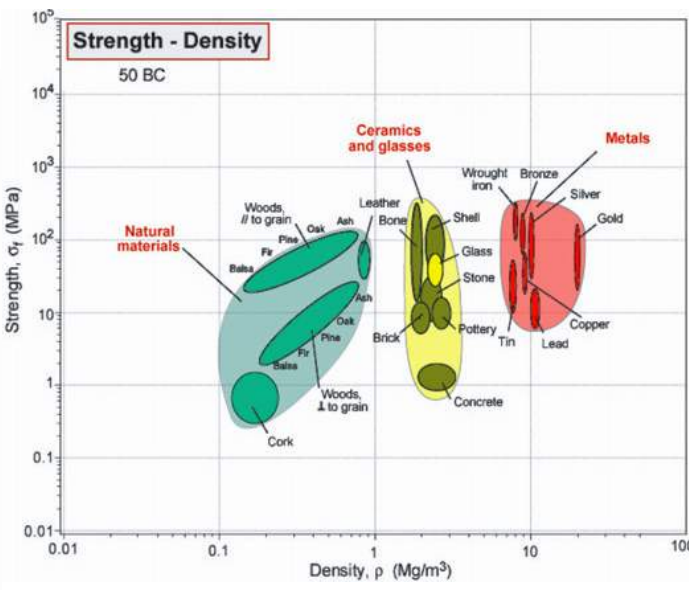
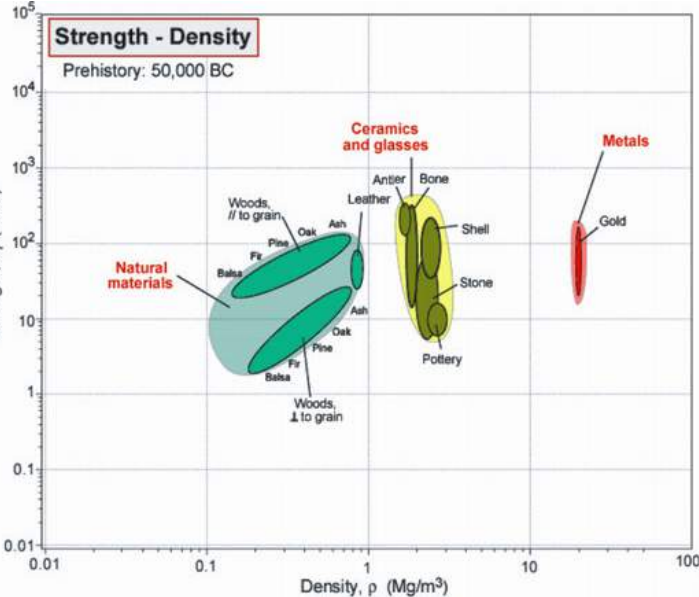
Compositi

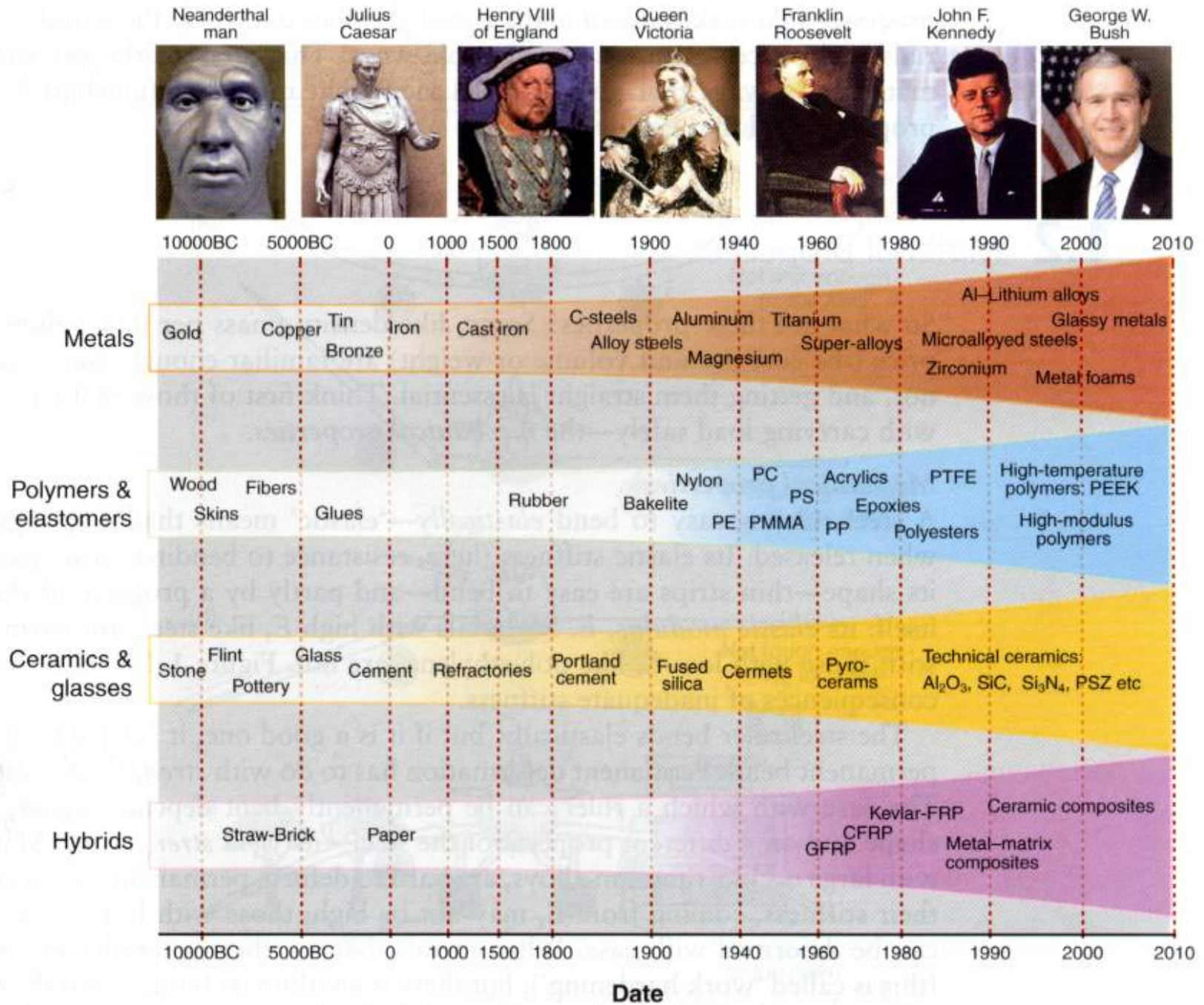


Progresso

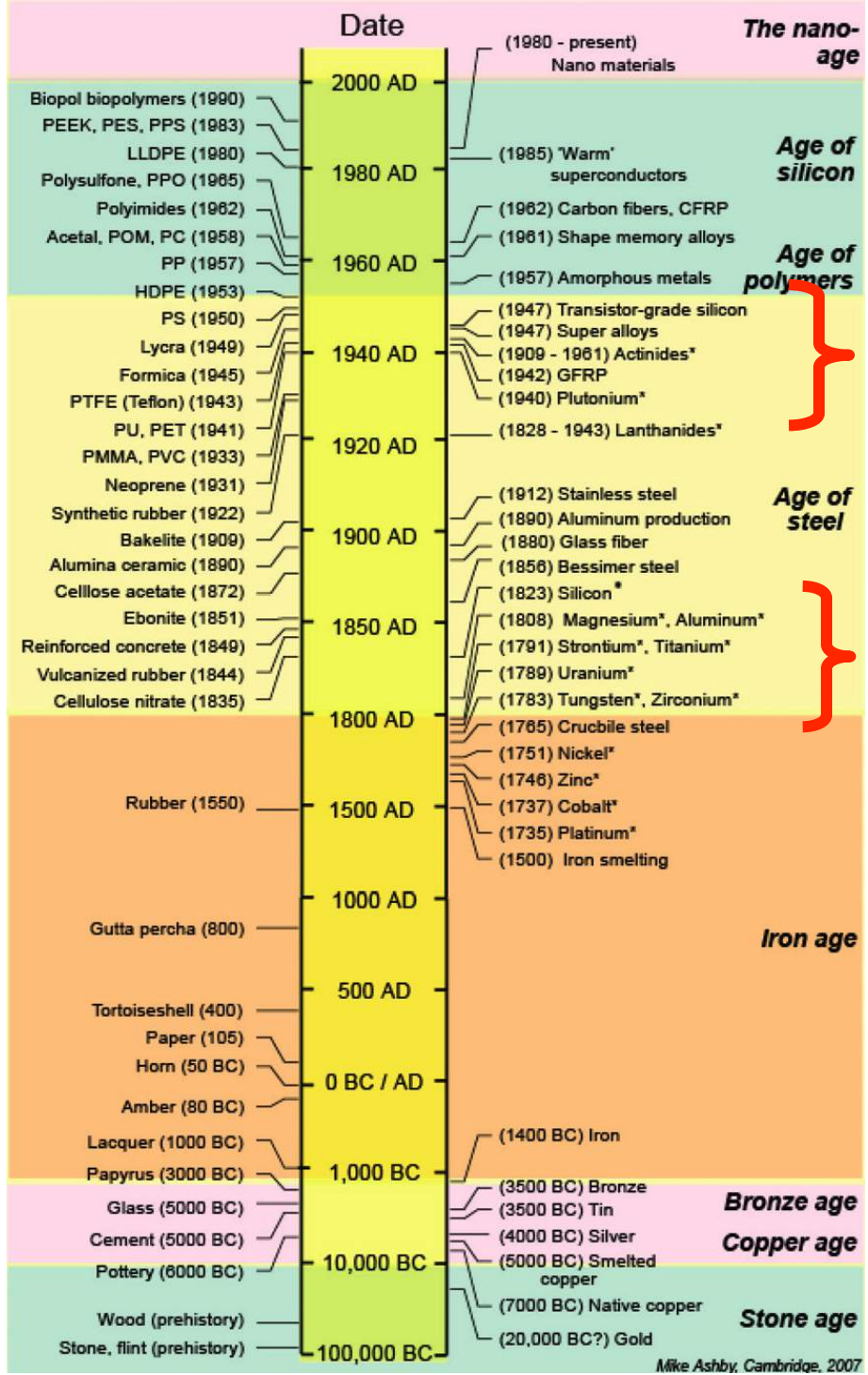


Progresso





Progresso



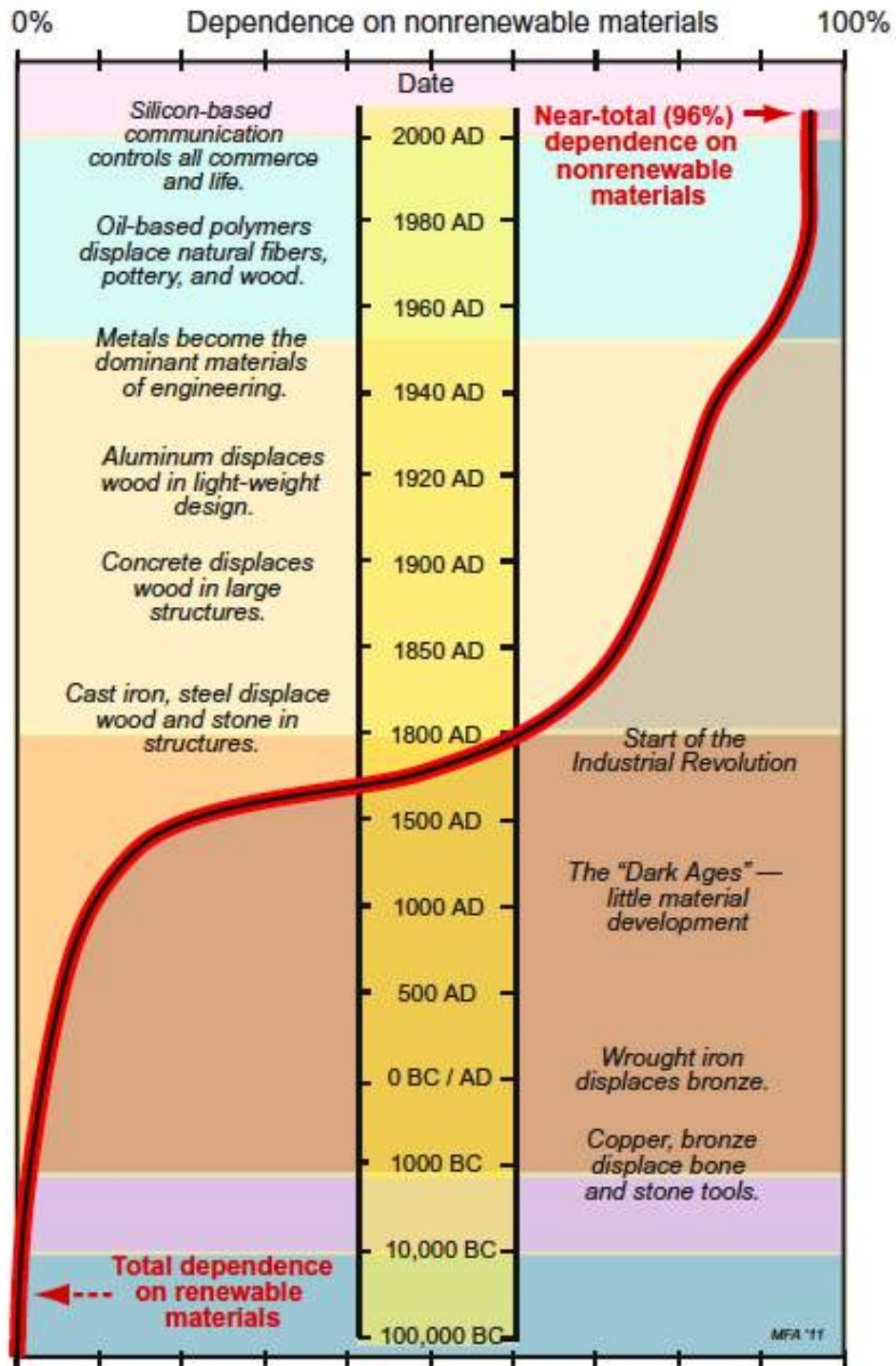
II World War

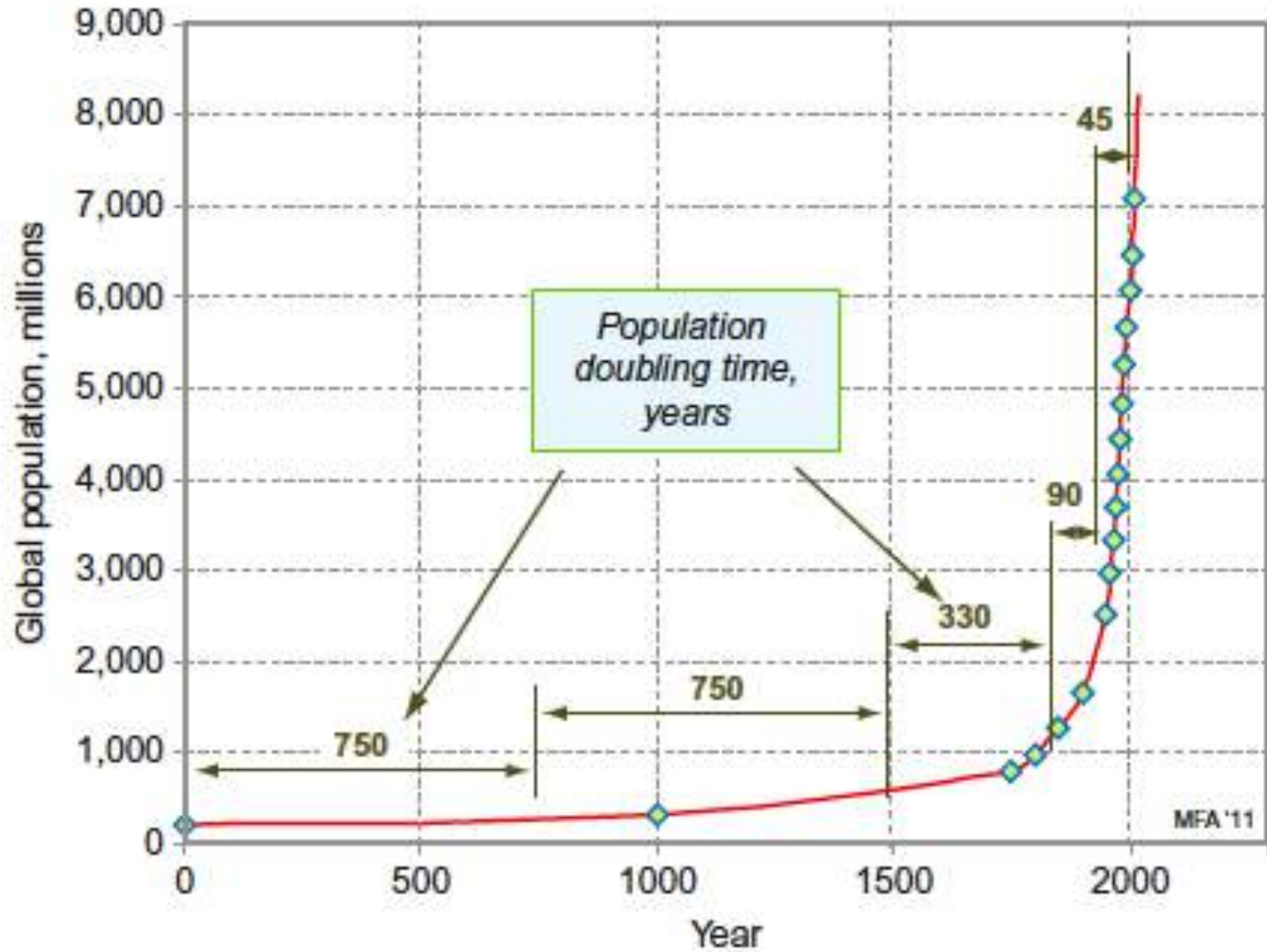
Napoleonic Wars

Roman Empire

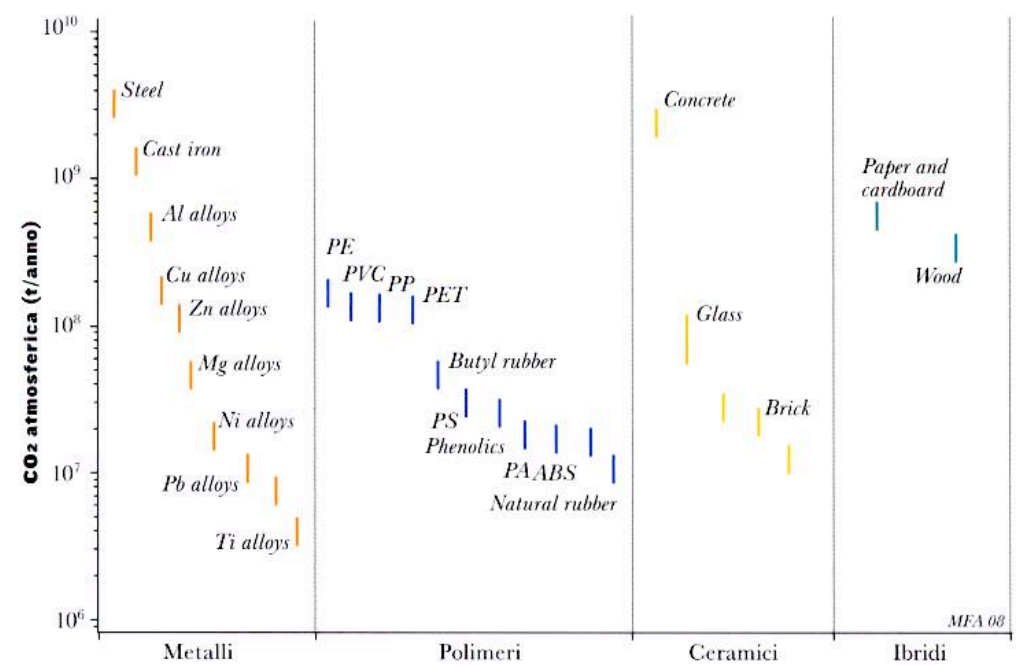
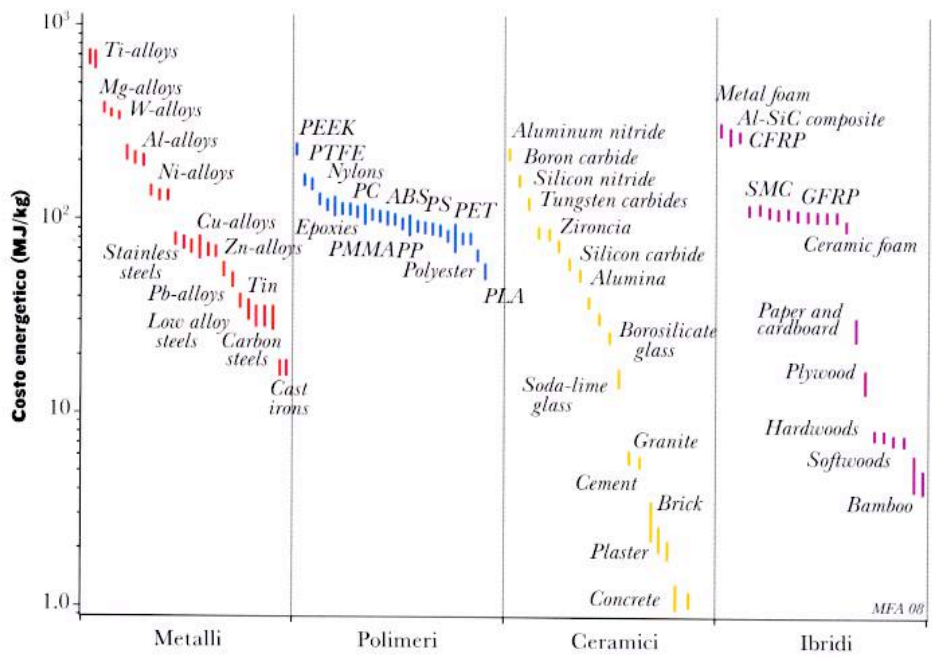
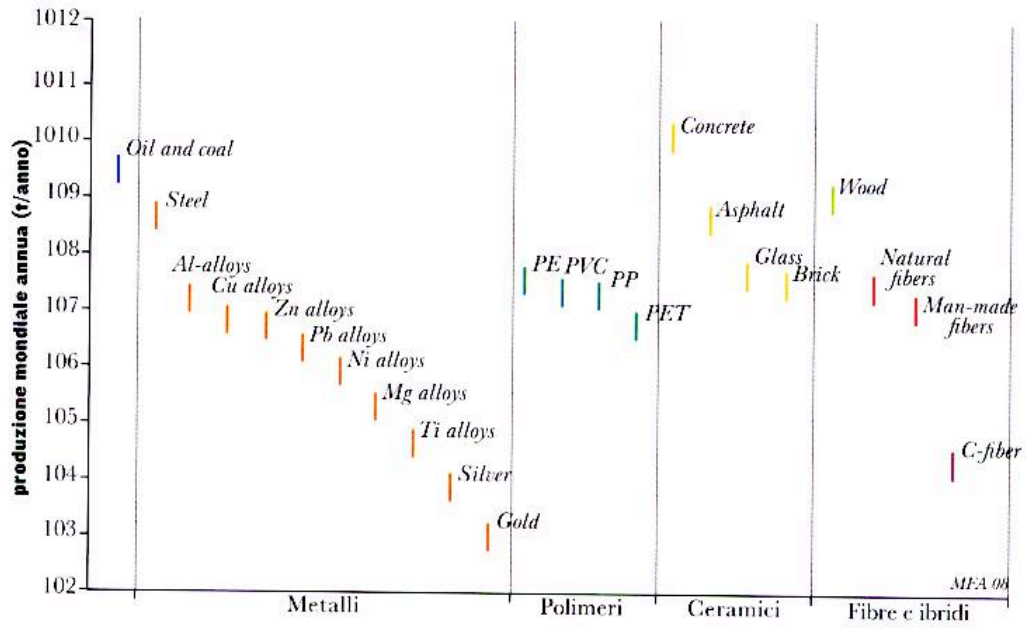
Mike Ashby, Cambridge, 2007

Progresso

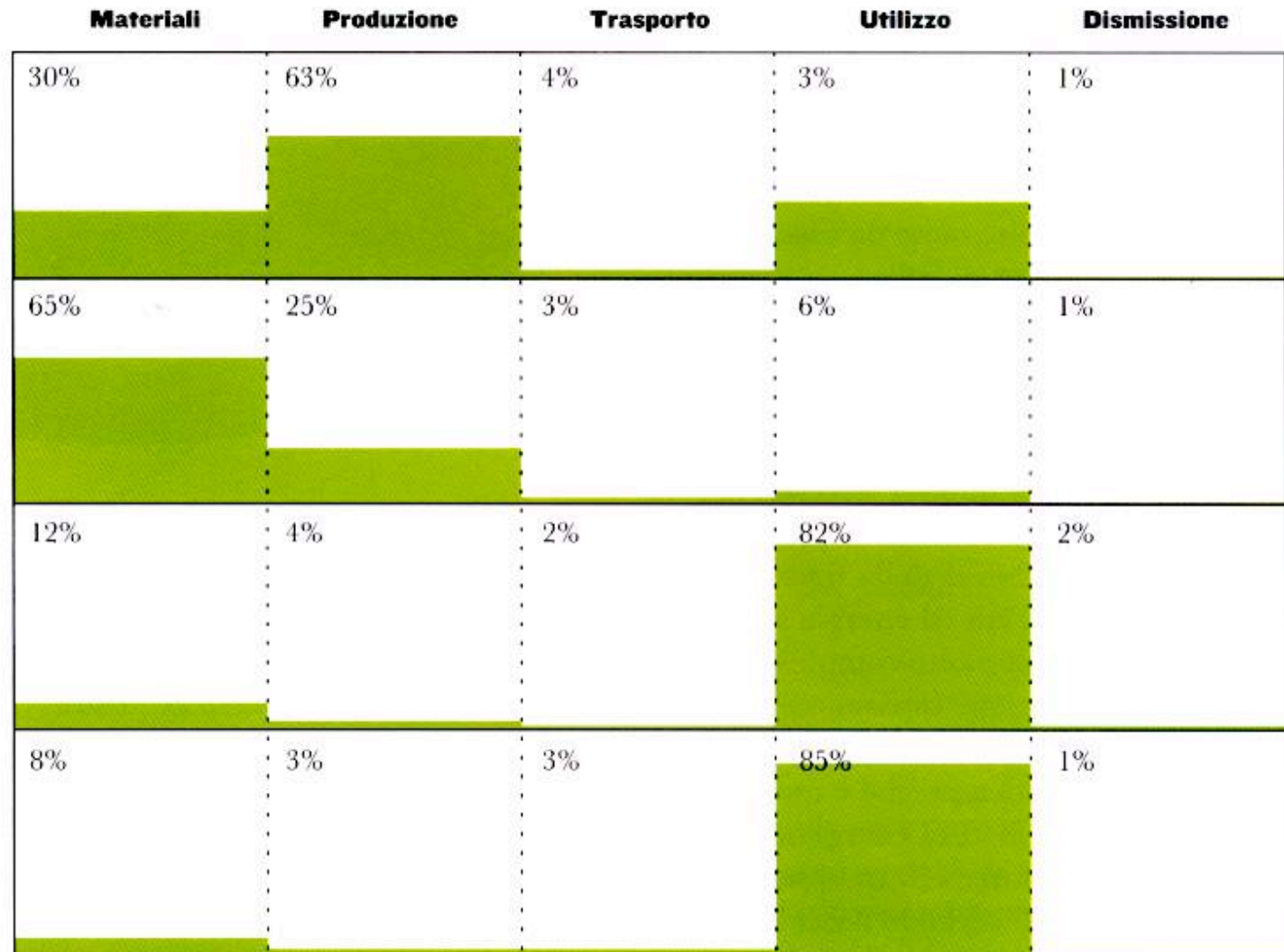
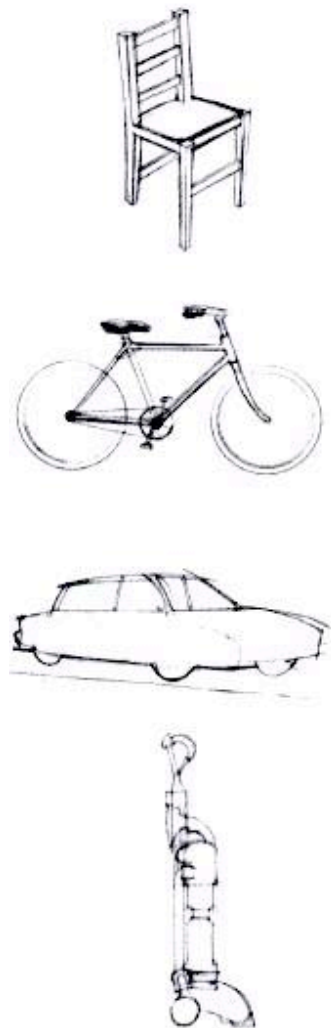


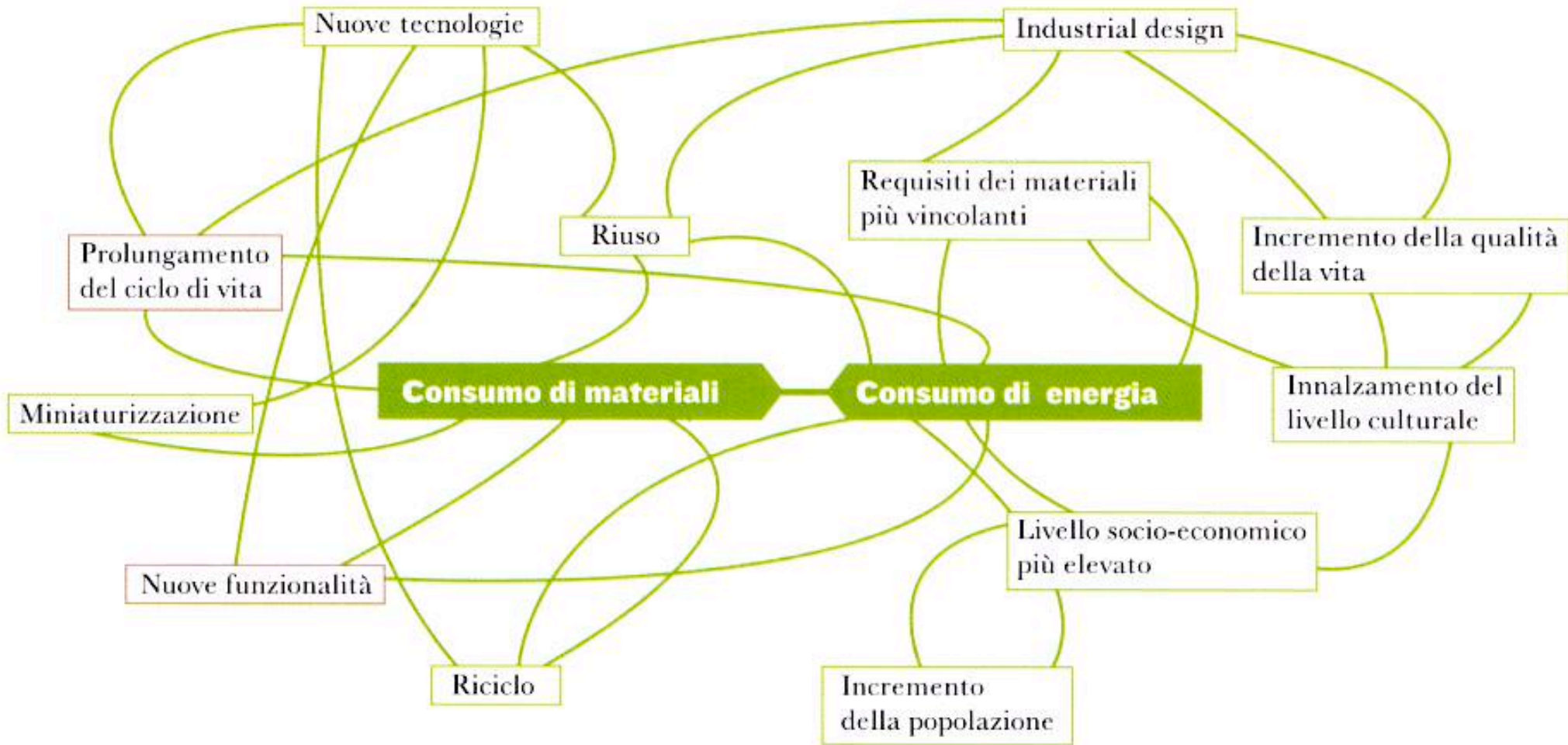


Energia



Energia





Età dell'energia !?

Alcune considerazioni conclusive:

- *Homo sapiens* si differenzia da tutte le altre specie animali per la sua competenza nel produrre “**oggetti-cose**” a partire dai diversi **materiali**, anche “**artificiali**”.
- In particolare, la differenza risiede nella **competenza** dimostrata dalla specie umana e nella sua abilità straordinaria di espandere e di adattare tale competenza con la **ricerca** e lo **sviluppo** (R&D).
- Le **conoscenze** e lo **sviluppo** di materiali sempre nuovi hanno una storia che accompagna quella delle civiltà umane a partire da tempi di gran lunga più remoti della Rivoluzione Industriale, spesso considerata, in un’ottica decisamente parziale e riduttiva, come l’inizio dei progressi tecnologici più significativi.
- Un aspetto che ha caratterizzato in maniera crescente le civiltà umane è la loro **dipendenza dai materiali**, un processo che oggi vede probabilmente il suo compimento, con una effettiva inversione dei ruoli. I materiali da “**umili servitori**” della umanità si sono trasformati in “**padroni**”, che influenzano le nostre scelte politiche, economiche, sociali.

Archeotecnologia dei Materiali
(Materiali, Tecnologie e Civiltà)

- Fine -