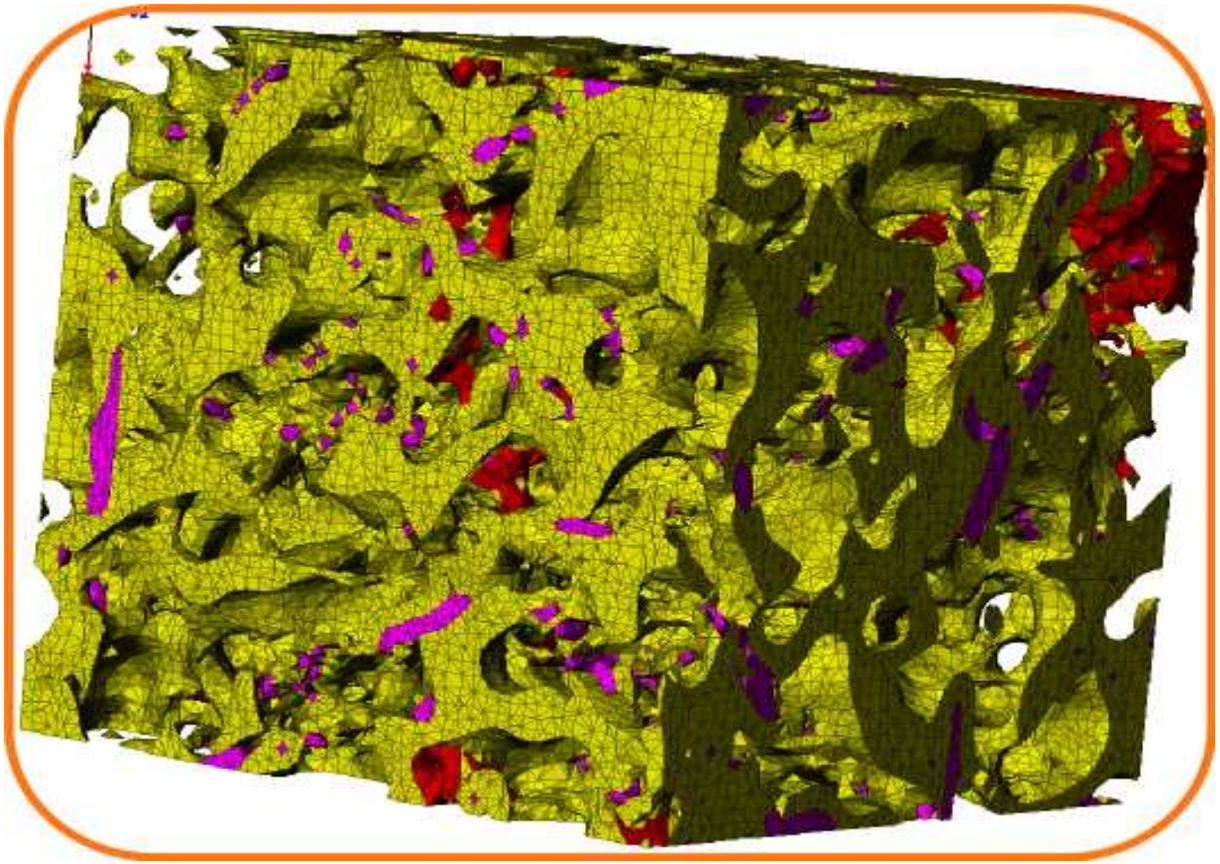
Matrix of composite



Contents of lecture

- Types of matrix composites
- Characterisation of nanocomposites :
  - PMC
  - MMC
  - CMC

Types of matrix

Matrix Type	Positive Attribute	Negative Attribute
Thermoset Polymer	Low Cost Processing	Brittle
Thermoplastic Polymer	Tough Formable	Cost Processing
Carbon	Thermal stability	Cost
Light Metals	Conductive Thermal resistance	Reacts with most fibers
Superalloys	Oxidation resistance	Heavy
Refractory Metals	High temperature strength	Heavy Oxidation
Glass	Corrosion resistance Low thermal expansion	Brittle
Glass/Ceramic	Corrosion resistant Thermal resistance	Brittle Cost
Ceramic	High temperature resistance	Cost

Matrix and composite

Matrix Type	Common Designation	Matrix Properties			Most Effective Reinforcement
		Stiffness	Strength	Ductility	
Polymer	PMC	Low (0.2 TO 0.5) msi	Low (0.5 TO 5) ksi	Low (< 2%)	Continuous Fiber
Metal	MMC	Moderate (6 TO 16) msi	High (10 TO 150) ksi	High (20%)	Continuous and Discontinuous Fiber
Ceramic	CMC	High (20 TO 80) msi	High (20 to 80) ksi	Low (< 1%)	Discontinuous Fiber or Whisker and Particulate

PMC nanocomposites

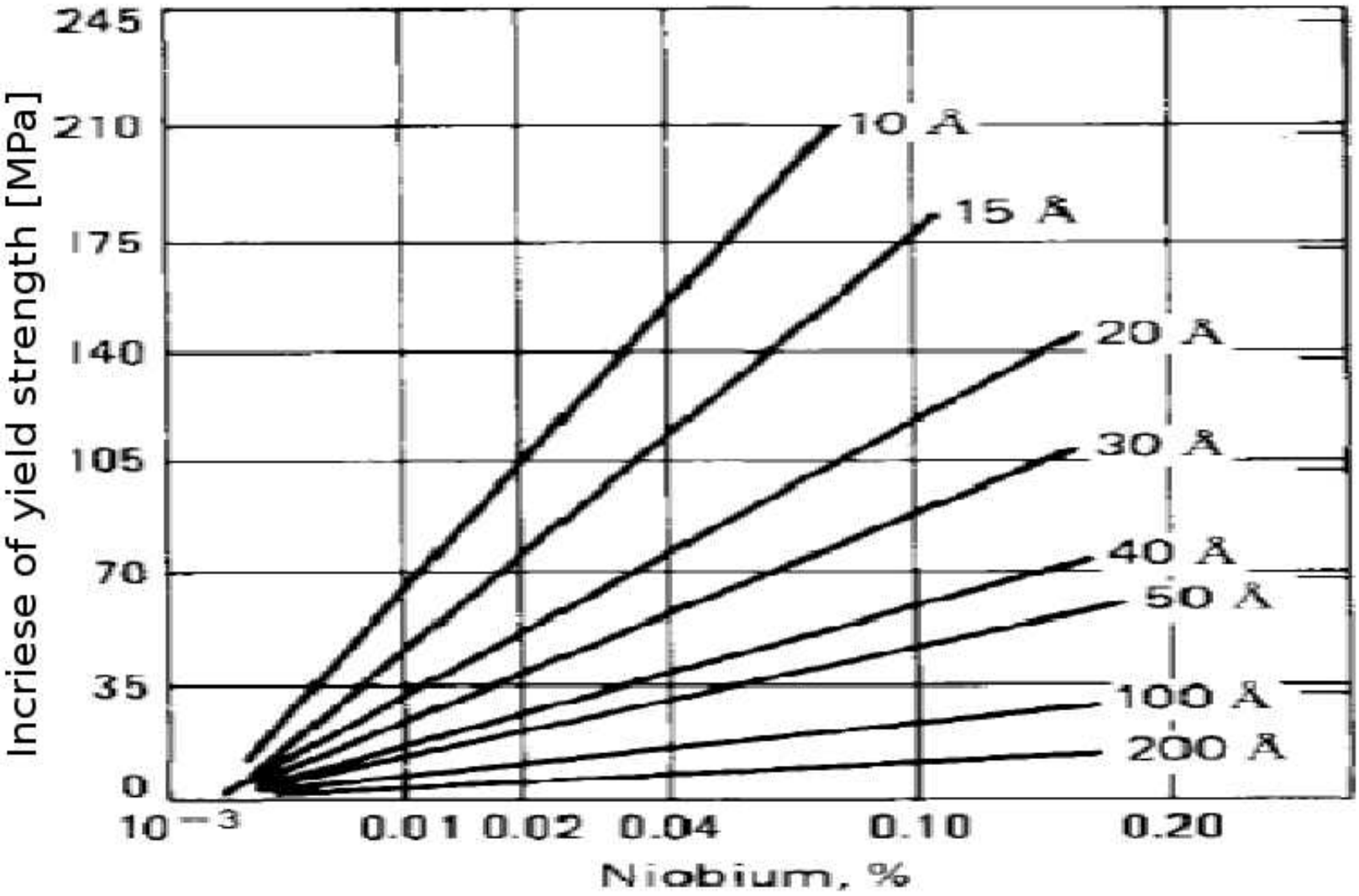
- Termoplastics : PA6, PMMA, PAN, HDPE, PP PS, PC
- Reactoplastics : epoxy, vinylester
- Often C nanotubes, below 5 %
- Increase of Tg, strength, rigidity (E), sometime ductility (epoxy)
- Disadvantage – more viscous melt

MMC nanocomposites

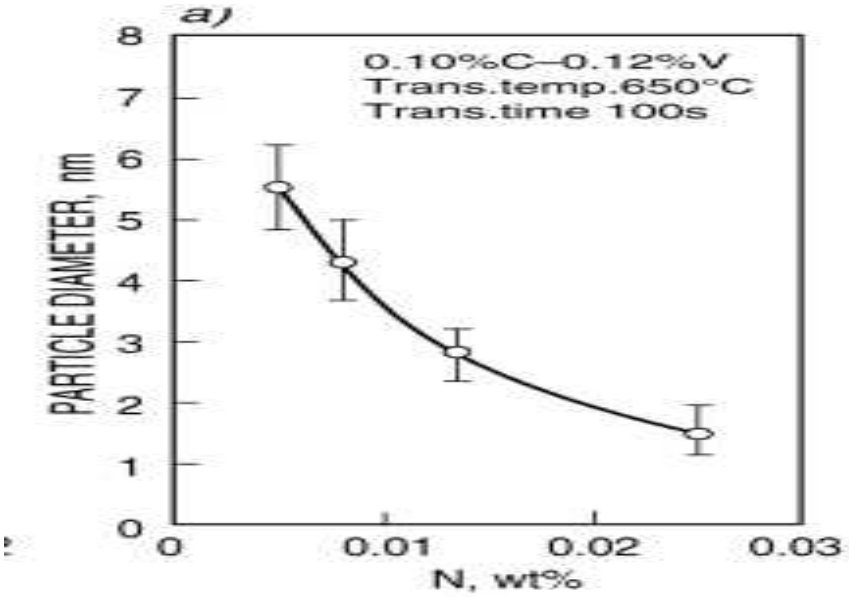
- Increasing creep resistance and high temperature strength
- Al, Ti alloys – oxides
- Cu alloys - oxides
- Sintering of nanopowders mutually insoluble metals - Bi + Co
- Microalloyed steels - vanadium, niobium
  - precipitation of carbonitrides

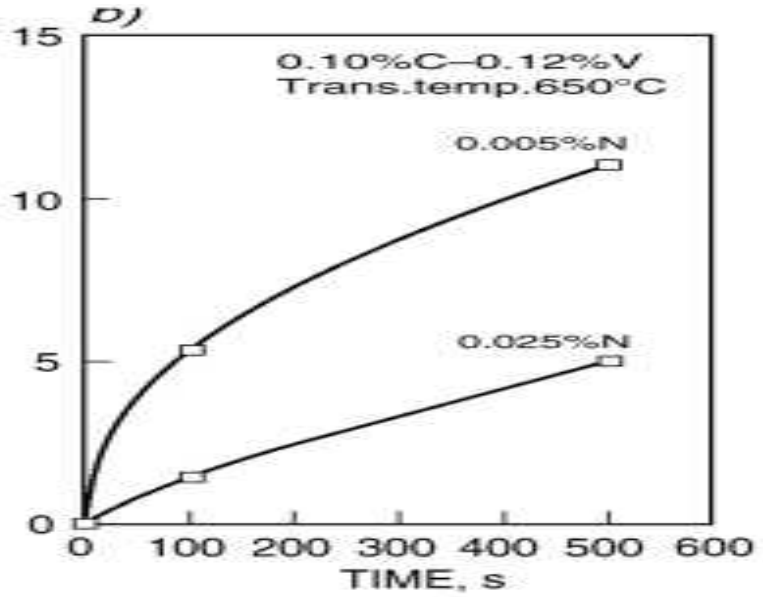
Niobium carbonitride in steel

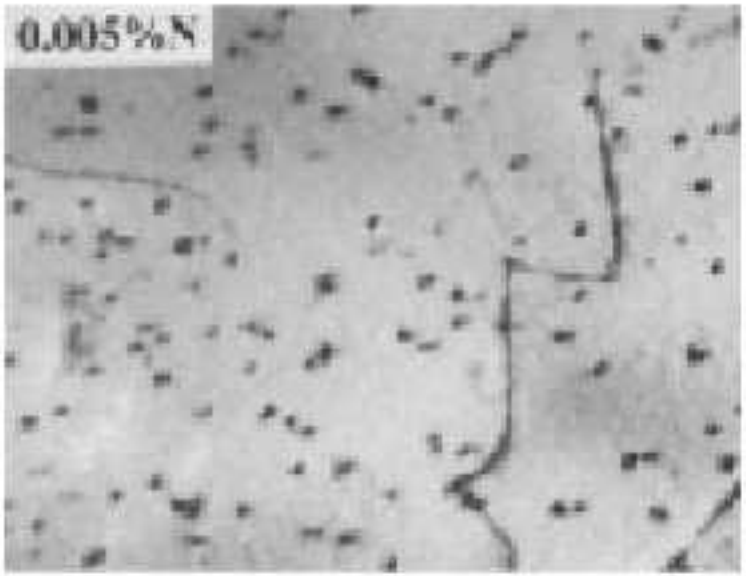
(10 angstraem ... 1 nm)

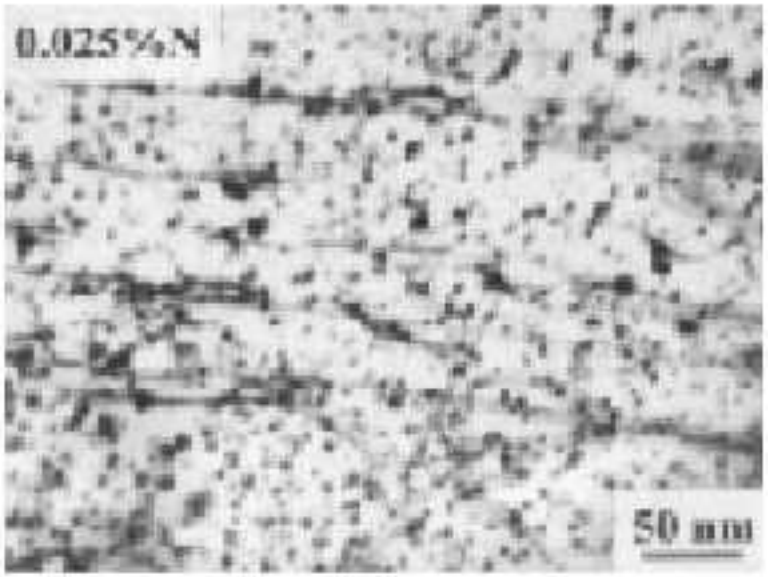


Vanadium carbonitride in steel









CMC - nanocomposites

- Increasing of thoughness and decreasing of hightemperature creep
- Trying to get nanoparticles inside the crystals of ceramic
- Short fibers reinforcement of ceramics
- Al_2O_3, ZrO_2, Si_3N_4
- Carbon matrix
- Glass matrix - eldest