Nano structured materials-synthesis, properties, self assembly and applications

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Module 4(Lecture 11& 12): Mechanical Properties

Problem :

1. What is the measure of deformation? (ductility)
2. Define Yield strength. (maximum stress before permanent strain)
3. Give the equation for calculating stress and strain. (Stress, $\sigma = F/A$; Strain, $\varepsilon = \Delta l/l_o$)
4. What are two types of elongation? (ultimate and elastic)
5. What is Hooke's law? ($\sigma = E\,\varepsilon$, where E is Young Modulus)
6. How will find modulus of any material? (from the slope of stress vs. strain)
7. What is the unit of Young Modulus? (Pa)
8. What is hardness? (resistance to plastic deformation)
9. How can you measure hardness? (by measuring depth or size indentation)
10. What is the range of tensile strength for fibre glass yarn? (1400-2000 MPa)
11. What is influence of size on mechanical properties? (increase hardness, yield strength, elastic modulus, toughness)
12. What is the reason for increase in mechanical strength with decrease in size? (less imperfections)
13. Give an example of a nanostructure with mechanical property. (CNT)
14. What is the reason for intrinsic strength of CNT? (C-C sp^2 bond)
15. Where do you find application of increased mechanical strength in biomedical sciences? (bone, implants)

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Solution :

1. ductility
2. maximum stress before permanent strain
3. Stress, $\sigma = F/A$; Strain, $\varepsilon = \Delta l/l_o$
4. ultimate and elastic
5. $\sigma = E\,\varepsilon$, where E is Young Modulus
6. from the slope of stress vs. strain
7. Pa
8. resistance to plastic deformation
9. by measuring depth or size indentation
10. 1400-2000 MPa
11. increase hardness, yield strength, elastic modulus, toughness
12. less imperfections
13. CNT
14. C-C sp^2 bond
15. bone, implants