I Read the text and answer the questions:

1 What are nanomaterials?

2 How can nanomaterials be classified?

3 What makes nanomaterials unique compared to other materials?

4 What are mechanical properties of nanomaterials?

5 How nanoparticles can improve the mechanical properties of materials?

6 Why is further research on nanomaterials necessary?

A nanomaterial refers to a material that has at least one dimension in a three-dimensional space or is reduced in composition to a nanoscale (1–100 nm) [1]. Nanomaterials can generally be classified into two types: nanostructured materials and nanostructured elements. In nanostructured materials, its structural dimensions are nanoscale. In nanostructured elements, at least one of the structural elements has an outer dimension within the nanometer range [2, 3]. Nanomaterials have unique properties compared with general materials. For example, the compressive and flexural strength of cement mortar with nano-SiO_2 or nano-Fe_2O_3 measured at the 28th day are both higher than those of the blank group [4]. Compared with microscale monolithic alumina ceramics, nano-Al_2O_3 ceramics have higher flexural strength [5].

Mechanical properties refer to the mechanical characteristics of materials under different environments and various external loads. Different materials exhibit different mechanical properties. As for the traditional materials, the mechanical properties of metals generally consist of ten parts, which are brittleness, strength, plasticity, hardness, toughness, fatigue strength, elasticity, ductility, rigidity and yield stress. Most inorganic non-metallic materials are brittle materials, which do not have properties such as plasticity, toughness, elasticity, ductility and so on. Besides, some organic materials are flexible materials, which do not have properties such as brittleness and rigidity.

Nanomaterials have excellent mechanical properties due to the volume, surface and quantum effects of nanoparticles. As nanoparticles are added to a common material, these particles will refine the grain to a certain extent, forming an intragranular structure or an intergranular structure, thereby improving the grain boundary and promoting the mechanical properties of materials [6, 7, 8]. For example, adding 3 wt/% nano-SiO_2 to concrete can improve its compressive strength, bending strength, and splitting tensile strength [9]. Adding 3% nano oil palm empty fruit string filler into kenaf epoxy composites can considerably improve their tensile strength, elongation at break, and impact strength [10].

Given that nanomaterials have excellent mechanical properties and unique properties that are not found in macroscopic materials, they have broad application prospects in the future.However, further research on nano-materials must be conducted. We need to

determine the mechanical properties of various nanomaterials to identify their possible engineering applications and industrial productions.

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II Vocabulary

Match the words from the text with their definitions:

1 nanomaterial	A. the capacity of a material to resist being crushed
2 mechanical properties	B. the resistance of a material to being pulled apart
3 filler	C. materials that can be esily broken
4 inorganic non-metallic materials	D. a material that has at least one dimension in a three-dimensional space or is reduced in composition to a nanoscale
5 organic material	E. the mechanical characteristics of materials under different environments and various external loads
6 nanoparticle	F. the dividing line between different grains of a material
7 refain	G. a small particle that has a size within the nanoscale
8 grain boundary	H. a substance added to a product
9 compressive strength	I. to improve something
10 tensile strength	J. a type of material that is derived from living organisms and is flexible