

# Properties of particles at Nanoscale

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## Abstract

Particles at nanoscale show anomalous behaviour. With the reduction in size, these particles at nanoscale show totally different properties rather than in their bulk part. In this report, different properties of different nanoparticles are compared and discussed.

Keywords: Nanomaterials, Magnetization

## 1. Introduction

Nanoscale properties of particles lying in the range of 1 to 100 nm are very interesting. Unique physical, chemical, magnetic and mechanical properties are observed for these small size particles than their bulk part [1, 2].

- 5 One of the most important properties shown by small particles is, Superparamagnetism. It is same as of paramagnetic, but the difference is that the value of magnetic moment for superparamagnetic particles is very large that's why here word 'super' is used [3, 4].

### 1.1. Classification of Nanomaterials

- 10 On the basis of dimensions, nanoparticles can be classified as follows.

1. Zero Dimension: When all the dimensions are in nanorange, these nanomaterials are known as zero dimension nanoparticles or simply nanoparticles, as shown in Fig.1.



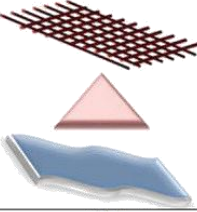
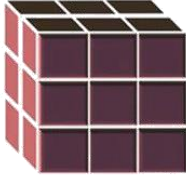
Isotropic nanomaterials	Anisotropic nanomaterials		
			
<b>0D</b>	<b>1D</b>	<b>2D</b>	<b>3D</b>
<b>Spheres, Clusters</b>	<b>Nanorods, wires</b>	<b>Nanofilms, plates</b>	<b>Nanoparticles</b>

Figure 1: Classification of nanoscale dimensions.

2. One Dimension: When two dimensions are in nanorange, then nanomaterials are known as one dimension nanoparticles or as nanorods, nanowires, nanotubes, as shown in Fig.1.
3. Two dimension: When one dimension is in nanorange, then nanomaterials are known as two dimension nanoparticles or nanosheets, nanofilms, as shown in Fig.1.
4. Three dimension: When no dimension is in nanorange, then these are known as bulk materials as shown in Fig.1.

## 2. Properties of Nanoparticles

Each type of particle are responsible for different properties of nanomaterials due to the presence of domains in these particles. In these domains, moments are present pointing in different directions. Moving from one domain to another, direction of moments get changed. The separation between these domains are known as grain boundaries, which are also known as Bloch walls. These arrangement of moments, give different properties of small particles. These particles also behave totally different than their bulk parts.

Size and shape of these particles are considered as another important factor affecting properties. With reduction in size of particles, materials start showing anomalous behavior. When it comes to single domain, these particles start

showing superparamagnetic behaviour. No hysteresis loop is observed in superparamagnetic nanoparticles. This behaviour of nanoparticles is caused due to the thermal fluctuations, which also have certain thermal energy. When anisotropy energy becomes less than thermal energy, then superparamagnetic behaviour is observed [5].

### 3. Applications of Magnetic Nanoparticles

Various applications are there for nanoparticles, especially magnetic nanoparticles. Family of iron oxide and hydroxide nanoparticles give us enormous applications [6]. One of the major achievements, for magnetic nanoparticles is in the field of medicine. These nanoparticles are used as drug delivery agents, for various treatments like to cure cancer [7].

### 4. Conclusion

The aim of this report is to describe the major effect of size of particles. With reduction in size, these particles give various applications in every field of science and engineering.

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