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 di erent properties rather than in their bulk part. In this report, di erent properties of di erent nanoparticles are compared and discussed.

Keywords: Nanomaterials, Magnetization

1. Introduction

Naoscale 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].

One of the most important properties shown by small particles is, Super-paramagneism. It is same as of paramagnetic, but the di erence is that the value of magnetic moment for superparamagnetic particles is very large thats why here word ‘super’ is used [3, 4].

1.1. Classi cation of Nanomaterials

On the basis of dimensions, nanoparticles can be classi ed as follows.

1. Zero Dimension: When all the dimensions are in nanorange, these nano-materials are known as zero dimension nanoparticles or simply nanopar-ticles, as shown in Fig.1.

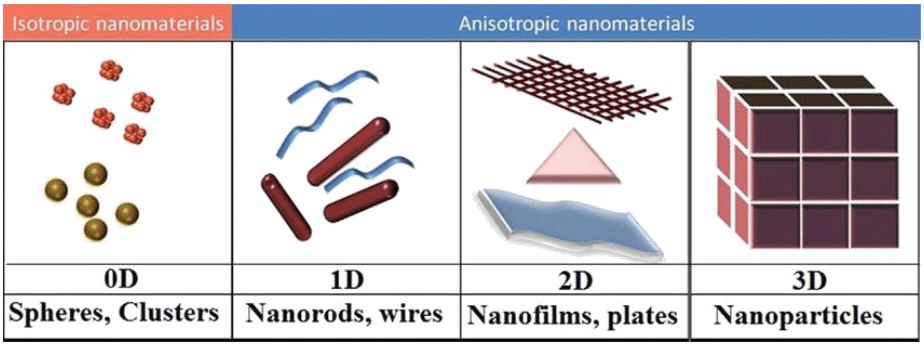

Figure 1: Classi cation of nanoscale dimensions

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2. One Dimension: When two dimensions are in nanorange, then nanomate-rials are known as one dimension nanoparticles or as nanorodes, 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, nano lms, 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 di erent properties of nanomaterials due to the presence of domains in these particles. In these domains, moments are present pointing in di erent 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 arrange-ment of moments, give di erent properties of small particles. These particles also behave totally di erent than their bulk parts.

Size and shape of these particles are considered as another important factor a ecting properties. With reduction in size of particles, materials start show-ing 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 uctuations, 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 eld of medicine. These nanoparticles are used as drug delivery agents, for varios treatments like to cure cancer [7].

4. Conclusion

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

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