Issues related to nanoparticles generation by exploding wire method

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Abstract. Nano science and nanotechnology continue to grow as fields of scientific research and commercial development. At this time, focus is to develop the particles of desired size with significant change of properties than bulk material. But the sample preparation methods involved in each process, surface functionliza tion and existing characterization techniques remains an important and complicated issue of nanoscience for the development of new materials till the present date. Thus for a science ,that is all about size, these important size issues need to be fully understood as it impacts not only the electronic and optical properties but also environmental and biological interactions. We are producing metal nanoparticles by exploding wire method. Vacuum plays an important role in the production of pure nanopowder as well as to avoid contamination and storage of the material to produce stable nanoparticles. In this paper we will discuss about the complications and intermediate process involved in the production of nano crystalline by exploding wire method.

1. Introduction
Nano technology is the modern incarnation of age old existing synthesis of nano materials like carbon black or beautiful texture in the paintings. With the advancement of science and detection techniques, it became a leading research in all basic cognitive sciences such as physical, earth science, biology and medicines with hope that, by reducing more and more the scale at which matter is manipulated, unprecedented control over material properties can be achieved[1-3]. The existing definition of nano materials shows that, nano material is a material, which is intentionally produced in the nano scale i.e approx 1-100nm, to have a specific property or a composition. This size boundary refers to the nano scale around which the properties of materials are likely to change significantly from bulk one. This impacts many collective properties, i.e colour, electrical conductivity, ability to absorb light, magnetic properties, which characterize bulk solids? Effort towards the functionalization, formulation, of nano materials is required to make them applicable in industry.

2. Issues related to nano particles generation
Many alternative methods have been proposed to realize production of particles with a controllable morphology: mechanical milling, precipitation, freeze-drying, spray –drying, emulsion based methods, chemical synthesis, and vapour deposition methods. Achievement of desired properties of nano materials depends upon various factors.
2.1 Size
Many fundamental properties are size dependant. Experimental setup for the production of nanoparticles is shown in figure 1 and collected sample is shown in figure 2.

![Experimental setup for nanoparticles production](image1)

Fig. 1. Experimental setup for nano particles production

![Photograph of collected sample](image2)

Fig. 2. Photograph of collected sample

On the nano scale, the total free energy is a sum of free energy of the free energy of the bulk and surface of the nanoparticles [4]. Surface free energy contributes largely with the decrease of size. Size affects the particle motion. In aqueous environments and as aerosol, there is a tendency of nanoparticles to form aggregates that are much larger than the primary size particles initially...
produced. So integral properties needs to be specified by number concentration, surface concentration and mass concentration.

2.2 Shape
Recently, there are number of research papers emphasizing the shape dependant properties variation on the nano scale [5]. Scanning electron microscope SEM) and transmission electron (TEM) and atomic force microscope are useful tools to see shapes and measure the distribution of nanoparticles. SEM and TEM images of collected sample are shown in figure 3 and figure 4.

![Fig. 3. Image of Scanning Electron Microscope of the nano particles sample](image1)

![Fig. 4. Image of Transmission Electron Microscope of the nano particles sample](image2)

For spherical particles, the measured diameter from different in struments can be related because no corrections need to be made for shapes, but for non spherical particles or agglomerates and aggregates that are irregularly shaped, volume equivalent diameter need to be formulated.
2.3 Surface contamination
Surface contamination is the most important part of the processing the materials which has the direct impact on the functionalization. Vacuum plays the important role in every stage of processing like production, storage, characterization. So in situ characterization techniques become important to avoid the surface contamination in larger extent and to avoid the loss of chemical activity of the material.

2.4 Excessive heat production problems
There are many processes where the generation of nanoparticles involves generation of heat as in exothermic reaction as well high temperature in laser ablation, exploding wire method, and plasma assisted nanoparticles generations process etc [6]. The rapid cooling process and sample collection process becomes crucial to get the desired shape size of the nanoparticles and of desired range.

2.5 Yield of the product
In all the above process, though the aim is to produce samples of mono dispersed, single-sized particles, more often than not there is a range of nanoparticles sizes each slightly different than the other than that produced. At this time it is often difficult to make the sample of nanoparticles containing exactly same number of atoms as like any molecular formula.

2.6 Characterization Techniques
To fully understand the properties of functional nano structures, it is necessary to know the portion of all the atoms in the nanostructures. It is difficult to quantify surface properties such as surface coverage and the number of functionalized groups at the interface of nanoparticles. Because of these difficulties, the development of suitable characterization techniques remains an important priority.

2.7 Environmental effect
nanoparticles are also difficult to handle in production process. Their impact on health and the environment has also become a serious concern. The process to recapture nanoparticles when they are released into the environment is difficult.

3. Conclusion
Critical issues involved in the generation of nanoparticles have been discussed. The whole process is a multi component dependant. New characterization techniques are required for the study of nanoparticles surface. The role of aggregation, reactivity of nano material surfaces and the functionality of the material after certain time period remains important challenge in nano material research.

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