STUDY ON SYNTHESIS OF MANGANESE NANOPARTICLES

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Abstract:

This paper discusses about the synthesis of manganese nanoparticles, which are spherical and are of faceted high surface area with metal nanostructured particles. The metal nanostructured particles are of 20-40 nm. Its principles existing methodologies, various trends followed in the synthesis are specified. Beyond that, why we prefer manganese for nanoparticles synthesis and its basic information is discussed. The main applications and the usage of manganese nanoparticles in different areas are discussed. This paper also describes about the methodologies and results occurred through them.

Keywords: Manganese nanoparticles, faceted, metal, nm.

I. Introduction:

Over the course of history, the advancement in the field of Nanotechnology is huge. A recent development in science and technology is to synthesize new and different kinds of nanoparticles (Nanowires, Nano sheets) with different methodologies. The size of these particles is of 1-100nm. In nanotechnology, a particle is a small object that which behaves as complete unit with respect to its transport and properties. Nanoparticles play a crucial role in a wide variety of fields such as environmental detection advanced materials, pharmaceuticals, and monitoring. Manganese oxide nanoparticles have a multitude of possible applications as gas sensors, catalysts, and airborne agent traps. Manganese nanoparticles can be conveyed by a couple of systems. They can be mixed using the unmoving gas development method where manganese is dispersed in an inert gas environment, and the vapor is allowed to cool by the including inactive gas particles. This results in the course of action of manganese nanoparticles, which are then accumulated and dissected through spectroscopy and diffraction frameworks. These nanoparticles have distinct advantages over their bulk
counterparts due to unique magnetic properties and enhanced surface-to-volume ratio. Although bulk MnO is antiferromagnetic, their nanoparticles show ferromagnetic ordering at low temperatures.

II. Synthesis Methods

The methods that are mentioned in tabulation are explained below with a brief description of the procedure:

1. Ball milling

2. Bio-synthesis

3. Green synthesis

4. Co-precipitation

5. Ultra-sonication

1. Ball milling:

A ball mill is a kind of processor used to granulate and mix materials for use in mineral dressing forms, paints, fireworks, pottery and particular laser sintering. A ball mill chips away at the standard of effect and steady loss; size decrease is finished by effect as the balls drop from close to the highest point of the shell. In instance of persistently worked ball process, the material to be ground is sustained from the left through 60° cone and the item is released through a 30° cone to one side. As the shell pivots, the balls are lifted up on the rising side of the shell and afterward they course down (or drop down on to the food), from close to the highest point of the shell. In doing as such, the strong particles in the middle of the balls and ground are decreased in size by impact[1].

2. Bio-synthesis:

Basically, Bio-synthesis is the process in which the simple molecules or compounds are modified and converted into complex compounds. This is also called as anabolism or biogenesis. This was done using microorganisms. For the combination of perfect, nontoxic and earth generous engineered advances the biosynthetic strategy broadly utilized. Microbial resistance against substantial metal particles has been abused for natural metal recuperation by means of lessening of the metal particles [2].

3. Green synthesis:

While metal nanoparticles are in effect progressively utilized as a part of numerous segments of the economy, there is developing enthusiasm for the natural and ecological wellbeing of their generation. The primary techniques for
nanoparticle creation are concoction and physical methodologies that are frequently unreasonable and conceivably unsafe to nature. The present audit is given to the likelihood of metal nanoparticle union utilizing plant extricates. This methodology has been effectively sought after as of late as an option, proficient, modest, and ecologically safe strategy for creating nanoparticles with indicated properties. This survey gives a nitty gritty examination of the different variables influencing the morphology, size, and yield of metal nanoparticles.

The primary centre is on the part of the common plant biomolecules included in the bio reduction of metal salts amid the nanoparticle amalgamation [3].

4. Co-precipitation:

Co-precipitation (CPT) or co-precipitation is the conveying around a hasten of substances ordinarily solvent under the conditions employed. There are three primary mechanisms of co-precipitation. They are inclusion, occlusion and adsorption. For the synthesis of nanoparticles, the following steps are followed; first anion and cation solutions are mixed which helps in nucleation and growth. Precipitation is formed by agglomerating the obtained solution. Then filtering and calcination are done inorder to synthesis Nano particles [4].

5. Ultra-sonication:

Ultra-sonication is the process of irradiating the liquid samples with ultrasonic waves of frequency greater than 20 kHz in agitation. This will create high and low pressure waves, which in turn gives us the division of the materials into sub particles, which are in the size of Nanometres [5].

III. Tabulation:

<table>
<thead>
<tr>
<th>S.no</th>
<th>Materials used</th>
<th>Method</th>
<th>Result obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mn flakes, Ethyl alcohol</td>
<td>Ball milling</td>
<td>By milling the Mn flakes in the pure ethyl alcohol and then homogenization Nano sized Mn powders were fabricated. [1]</td>
</tr>
<tr>
<td>2</td>
<td>Manganese sulphate, Streptomyces</td>
<td>Bio-synthesis</td>
<td>By using Streptomyces manganese sulphate is reduced to manganese nanoparticles[2]</td>
</tr>
<tr>
<td>3</td>
<td>Manganese acetate, Lemon extract, Turmeric cur cumin</td>
<td>Green synthesis</td>
<td>By reducing manganese acetate into manganese using natural products i.e., lemon extract, turmeric cur cumin[3]</td>
</tr>
<tr>
<td>4</td>
<td>Manganese(II) sulphate, Manganese oxalate, EthanolNaOH</td>
<td>Co-precipitation Using green chemistry</td>
<td>Using green chemistry, MnO2 nanoparticles are fabricated by co-precipitation method[4]</td>
</tr>
<tr>
<td>5</td>
<td>Manganese(II)acetate, Milli-Q water, Erlenmeyer flask, Sonicator</td>
<td>Ultrasonic bath Method</td>
<td>Manganese nanoparticles are obtained by ultra-sonication[5]</td>
</tr>
</tbody>
</table>
The above tabulation represents the various results obtained for different methods and different materials used. And the various results that followed by implementing the methods using the pertaining materials that belong to the synthesis methods. Now the applications involved in the usage of the synthesis methods are brought to light.

IV. Application

The main applications of manganese Nanocrystals are:-

1. Magnetic resonance imaging: In magnetic resonance imaging (MRI), the manganese Nano-crystals are used as contrast agents. These particles are used to label cells, for the purpose of tracking and also help in increasing the MR contrast [6]. This is specifically used as MRI contrast agent for liver imaging when combined with ferrite nanoparticles.

2. Biosensors: In biosensors, manganese is used in addition with carbon to detect hydrogen peroxide, which is in the range of cellular cycle of living beings. Such that, these type of bio sensors can be used in medical and industrial diagnosis. This is also used in detection of Ractopamine using electrochemical biosensor (manganese (II) phosphate Nano-flowers).

3. Magnetic data storage: For energy storing, manganese dioxide ink is widely used which is of 30 times better than that of commercial capacitor of same weight. These nanoparticles are used in super capacitors, which can store a large amount of data. These are also used in harnessing the power of Skyrmions (stable magnetic structures).

4. Ceramics: Manganese can be used in glass making. When manganese particles can make a ceramic glaze look like a metallic sheet when used in high concentration. It can also change colors when mixed with different chemicals.

Based on the present technology, manganese can be a part of electronic, as spintronic material (which means spin transport electronics), ferrites for electromagnets, Tantalum capacitors.

V. Conclusion

The Nano particles of manganese are synthesized using different methods like ball milling, bio-synthesis, green synthesis, co-precipitation, and ultra-sonication are described. Not only the methods, but also the materials used and the results obtained are also described. The explanations for these methods are given within the tabulation. This also described why manganese was chosen for Nanoparticles synthesis. The major applications of manganese are also explained in detail.
VI. References


