

Nanotechnology: From Ancient Indian Culture to Contemporary World

* Yogita Madan

**Anshu Jain

Abstract

Nanotechnology may appear to develop and flourish by the end of 20th century, with the advent of highly sophisticated equipment's. However, studies on Indian culture reveal that it was prevalent in the form of nanomedicines, "bhasma" as well as colorant in glass and ceramic industries. Indian craftsmen used nanotechnology in wurtz steel. It has also been reported that carbon nanotubes were found in the sword of Tipu Sultan and in the Ajanta Paintings. These illustrations from ancient India suggest that nanotechnology has already taken roots in India. Nowadays, owing to advancement in technology, nanomaterial's have found various profound applications in our daily life viz.; electronics, catalysis, biology, medicines etc. This communication intends to present a brief overview on applications of nanotechnology from ancient India till the contemporary world. It has also been discussed that how the understanding and pursuing the old world knowledge in conjunction with modern technological advances yields greater scientific knowledge for benefits of environment and mankind.

Keywords : Green Nanotechnology, Bhasma, Carbon nanotubes, Ancient World

Introduction

Nanotechnology can be defined as the technology used for design and synthesis of materials which is having atleast one spatial dimension in nanorange *i.e.*, 1-100 nm (10^{-9} to 10^{-7} m). The term "nano" which is one billionth of a meter, originated from Greek Word, "nanos" which means dwarf [1]. The concept of nanotechnology was first put forward by physicist Richard Feyman in 1959 in his talk entitled "**There's plenty of room at the bottom**" [2] New properties are incorporated to the matter at the nanoscale, which makes it suitable for the development of new products with new functions [3]. Nanotechnology may appears new in every aspects and a contemporary world's invention, but there are many historical references which claim that ancient India was well acquainted with this technology [4].

Evidences of nanotechnology in Ancient Indian Culture

"Bhasmas" as nanomedicine of Indian culture

In India, the concept of reduction in particle size of precious metals has been prevalent since ancient times. It is clearly evident from the oldest classical text in Aryurveda, "Charak Samhita". Bhasmas are unique herbo-metallic/mineral formulation, prescribed in very minute dosage for treatment of

Nanotechnology: From Ancient Indian Culture to Contemporary World

Yogita Madan & Anshu Jain

variety of chronic diseases since 7th century. These are nontoxic, easily digestible and absorbed in the body [5]. Bhasmas, an ash, are claimed to be biologically produced nanomaterials [6]. These are prepared by purification of starting material (process is known as Shodhana) followed by the incorporation of mineral/herbal extracts in next step *i.e.*, reaction phase. The material prepared in pallet form is further subjected to incineration to obtain a nontoxic, lustureless ash, known as bhasma. Swarna ash (Gold bhasma) has been characterized to contain particle size of 56-57 nm. The bhasmas are useful in maintaining optimum alkalinity in body, stronger bones & teeth, maintaining mineral balance and metabolizing iron in body etc. Lauha bhasma (Iron) is documented to possess good potential as therapeutic agents [7].

Carbon Nanotubes in Ancient Handicrafts and Iron Equipment's

Chemistry's Noble Laureate Robert Floyd Curl Jr. (1996) explained that the concept of nanotechnology was utilized over 2000 years ago in India by the craftsmen crafts men in the manufacturing of wootz steels and paintings. Carbon nanotubes and cementite nanowires have been found in a sample of wootz steel with the aid of high-resolution microscopy [8]. Wootz steel was manufactured by unique smelting process, which led to nanotization, giving it a long lasting edge. It also had 1.5% carbon, incorporated by wood and organic matter, during fabrication. The presence of these nanostructures has high impact upon mechanical properties. It can be clearly seen in the reference made to the sword of Tipu Sultan, an eighteenth century king of Southern India, where the strength of sword can now be explained by nanotechnology [9]. Carbon nanotubes were also found in Ajanta paintings. These nanotubes are cylindrical fullerenes with extraordinary strength in terms of elastic modulus and tensile strength.

Nanotechnology in Current Scenario

Nanotechnology, in current state, is a revolutionary technology, so profound that it touches all parts of human society. The properties of nanomaterials differ significantly from bulk material. Nanoparticles possess enhanced structural integrity as well as unique optical, chemical, electronic, magnetic and mechanical properties owing to which, nanomaterials have become significant in recent years. Newly synthesized nano-products are coming to market rapidly in the diverse areas of energy, agriculture, environment, health and consumer goods [10].

Need of Green Nanotechnology

Green nanotechnology may be defined as technology applied for developing clean technology by which reduces potential risks to environment and human health to a great extent. The tremendous demand of nanomaterials has put pressure for its continuous synthesis by incorporating the methods which usually employ toxic chemicals and yield non-biodegradable wastes [11]. Occupational health risks associated with the manufacturing and use of nanomaterials over a range of biological composition and sizes can be reduced by the development of green experimental protocols. The knowledge of ancient Indian practices to synthesis biocompatible/ecofriendly nanoparticles can be used to broaden the spectrum of today's nanotechnology.

Conclusion

Instances from past proves that ancient India was familiar with the manufacturing of nanomaterials, although they were unaware of term, nanotechnology. In today's world, nanotechnology is an emerging scientific field which has the potential to radically generate new products and processes by using nanomaterials and characterized the use of sophisticated instruments.

Nanotechnology: From Ancient Indian Culture to Contemporary World

Yogita Madan & Anshu Jain

* Assistant Professor, Deptt. of Chemistry, Amity School of App. Sci., Amity University
** Research Associate, Department of Chemistry, MNIT Jaipur (Raj)

References

1. A. Gade, M. Rai, A. Yadav, Current [corrected] trends in phytosynthesis of metal nanoparticles, *Crit. Rev. Biotechnol.*, 2008, 28(4), 277-284.
2. (i) Eric. Drexler, "There's Plenty of Room at the Bottom" (ii) R. P. Feynman, (1961). There's plenty of room at the bottom. In H. D. Gilbert (ed.), *Miniaturization*. New York: Reinhold
3. B. S. Sekhon, Nanotechnology in agri-food production: an overview, *Nanotechnol Sci Appl.*, 2014, 7, 31-53
4. A. Kumar, Nanotechnology Development in India, An Overview, RIS-DP # 193, 2014
5. A. N. Garg, A. Kumar, A. G Nair, A. V Reddy, Bhasmas: unique ayurvedic metallic-herbal preparations, chemical characterization, *Biol Trace Elem Res.*, 2006, 109(3), 231-254.
6. A. Haldar, D. K. Pal, C. K. Sahu, Bhasma : The ancient Indian nanomedicine, *J Adv Pharm Technol Res.*, 2014, 5(1), 4-12.
7. M. K. Dash, L. K. Dwivedi, N. Joshi, G.D. Khilnani, Toxicity study of Lauha Bhasma (calcined iron) in albino rats, *Anc Sci Life.*, 2016, 35(3), 159-166.
8. Materials - Carbon nanotubes in an ancient Damascus sabre, *Nature* 444(7117):286 . December 2006
9. J. K. Nair, Nanotechnology in Ancient India, January 7, 2008 History: Before 1 CE
10. <https://www.nano.gov/you/nanotechnology-benefits>
11. (i) S. Belluoca, F. Gallochioa, A. Ricci, Nanotechnology and Food: Brief Overview of the Current Scenario, *Procedia Food Science*, 5, 2015, 85-88 (ii) <http://www.cense.iisc.ac.in/news/nanotechnology-india-current-status-and-future-prospects>

Nanotechnology: From Ancient Indian Culture to Contemporary World

Yogita Madan & Anshu Jain