NANOTECHNOLOGY AND ITS ROLE IN THE ENVIRONMENTAL SUSTAINABILITY

An overview of the Nanotechnology Public Engagement (NPEP) programme

The Nanotechnology Public Engagement (NPEP) programme is an initiative funded by the Department of Science and Technology (DST) and implemented by the South African Agency for Science and Technology Advancement (SAASTA), the business unit of the National Research foundation (NRF). Launched in early 2008, the NPEP programme aims to promote credible, fact based understanding of Nanotechnology through awareness, dialogue and education to enable informed decision making on Nanotechnology innovations to improve the quality of life.

The objectives of the Nanotechnology Public Engagement Programme are to:

- Create awareness around nanotechnology;
- Educate the public on, and enhance their understanding of nanotechnology;
- Enable and stimulate meaningful public debate around nanotechnology; and
- Stimulate interest in nanotechnology and nanoscience as a career in order to ensure long term capacity building in the field;
- Get industry involved in the development of nanotechnology and taking the lead in nanotechnology innovation.

The success of any awareness programme depends largely on how the message being conveyed is formulated and/or articulated. For a variety of reasons, different societal groupings require different forms of information formulation and articulation. To enable the articulation of the messages to suit the needs of different societal groupings and effect optimum results, the target audience has been divided into four categories. These are:

a) **Learners**,
b) **Science Community,**
c) **General Public and**
d) **Industry**

Thus the main purpose of the NPEP is to implement the activities aimed at informing and educating the public about nanoscience and nanotechnology. The Nanotechnology Public Engagement Programme is therefore part of the implementation of the National Nanotechnology Strategy.

Nanotechnology and its role in the environmental sustainability

Nanotechnology, unlike other technologies, can find applications in virtually all areas of human life. In spite of being an infant at its evolution, some of the known issues related to nanotechnology suggest a wide spectrum of potential societal impact. It is for that reason that the cultivation of a climate of public discourse is essential to provide an opportunity for a society to switch from a merely passive, observational role to an active participating one.

Some of the most essential challenges facing global societies in the 21st century include the sustainability of the environment (water, soil and air quality), energy, health and food. For a long time, the concept of sustainable development has been debated and has largely been driven by emphasis on new technologies and innovations. Existing technologies face serious challenges due to the fact that new and emerging industries continue to generate formidable and complex emissions/pollutants that are released to the environment. Pollutants from pesticide and fertiliser runoff, runoffs from chemical industries and poor human settlements, abandoned industrial sites and mines, as well as airborne gaseous emissions from industries and automobiles continue to aggravate the situation on a daily basis. Scientists believe that new environmental technologies at the nanoscale (environmental nanotechnologies) could substantially enhance environmental quality and sustainability through pollution prevention, treatment and remediation.[1]

Nanotechnology refers to the design, characterisation, production, and application of structures, devices and systems by controlled manipulation of size and shape at the nanometre scale (atomic, molecular and macromolecular scale) that produces structures, devices and systems with at least one novel/superior characteristic or property. A nanometre (nm) is a unit of length in the metric system, equal to one billionth of a metre (m) (i.e. 1 nm = 10^{-9} m or 1 m = 10^{9} nm). Scientists describe nanoscience as the study of phenomena and manipulation of material at the nanoscale.[2] The ability of humankind to create and manipulate matter at the nanoscale offers previously unenvisaged possibilities for scientific discoveries and technological applications. This is related to the discovery of tools such as the atomic force microscope (AFM), the scanning tunnelling microscope (STM) and high-resolution electron microscopes, which have enabled us to observe and manipulate nano-sized materials.

The past two decades have seen rapid global advances in nanoscience and nanotechnology in all spheres of science, engineering and technology. Scientists, including chemists, biologists, physicists, and engineers (electronic, chemical etc.), continue to explore the potential positive and negative effects of nanotechnology-based materials and devices. South Africa is not an exception. Among other benefits of nanotechnology, the ability to deliver improved technologies for environmental sustainability offers great relief for societies and the promise of realising a “green vision”.

To date, leading South African universities (University of the Witwatersrand, University of Johannesburg, University of Cape Town, University of the Western Cape, University of Pretoria, University of Zululand, Tshwane University of Technology, University of Stellenbosch, University of the Free State and others), the DST’s Nanotechnology Innovation Centres (the CSIR’s National Centre for Nano-Structured Materials and Mintek) and the industrial and private sector (Water Research Commission, Eskom, Sasol, BASF, NECSA, iThemba labs, Anglo Gold, Plascon, Dulux, etc.) are engaged in nanotechnology research and the development of new materials that will ensure

sustainability. Other groups at the CSIR's Natural Resource and the Environment Unit are focusing primarily on the potential environmental, health and safety risks of nanotechnology to ensure long-term sustainability of nanotechnologies.
Following the launching of the South African National Nanotechnology Strategy was launched in April 2006; the NRF (National Research Foundation) identified the following areas which relate to its mandate:

- Investing in final-year undergraduate and postgraduate bursaries;
- Strengthening human resources capacity in industry in nanotechnology through programmes and internships;
- Encouraging interdisciplinary and inter-institutional postgraduate programmes in nanoscience and nanotechnology;
- Promoting collaborative R&D in nanoscience and nanotechnology;
- Contributing to the establishment of strategic support networks in South Africa and regionally.

In partnership with the Nanotechnology Equipment Programme that resides in the NRF, the Public Engagement with Nanotechnology (PEN) programme that falls under science communication at the South African Agency for Science and Technology Advancement (SAASTA) aims to market, communicate and disseminate the scientific information that stems from all funding endeavours. It is with these strategic directives in view that the PEN programme identified the need to have a more engaged and informed society around nanotechnology which would ultimately speak to the NRF Vision 2015 which has "Transformed society" as one of three key focus areas.

References

1. T. Masciangioli and W. Zhang, *Environmental Science and Technology* 102A-108A (2003).

2. http://www.nanowerk.com/nanotechnology/introduction/introduction_to_nanotechnology_1.php] (accessed 26.05.2010).

3. D. Hristozov and J. Ertel, *Forum der Forschung* No. 22 (2009) 161 -168.