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SURVEY ON NANOTECHNOLOGY IN SPACE

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Abstract--Quantitative analysis of statistics about agreement and disagreement with two statements, one positive and the other negative reveals high levels of enthusiasm for the potential benefits of nanotechnology and little concern about possible dangers. The respondents mentally connect nanotechnology with the space program, nuclear power, and cloning research, but rate it more favorably. In contrast, they do not associate nanotechnology with pseudoscience, despite its imaginative exploitation by science fiction writers. This paper converse about the introduction of nanotechnology, advantages and disadvantages of nanotechnology in space and issues presented in nanotechnology.

I. INTRODUCTION OF NANOTECHNOLOGY

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering [1].

1.1 Nanotechnology used in space

- With materials like these we may be able to find ways of launching into orbit that involve costly rockets (and their costly fuel.) Researchers are particularly excited about the possibilities for a space elevator.
- Carbon nanotubes are the perfect choice for such an elevators cable, since nanotechnology is able to create carbon-based material that is light in weight yet strong enough to withstand the forces it would face in space.
- A space elevator would make all kinds of pioneering efforts possible by dramatically reducing the cost of sending things into orbit.
- This becomes painfully obvious when one considers that 95% of a space shuttles takeoff weight is entirely devoted to fuel storage.
- Despite the amusing and whimsical idea of an elevator that reaches all the way into space, scientists are perfectly serious about this endeavor and have already anticipated such practicalities as how and where the two ends of its cable will be anchored, the Earth end will be affixed to a sea anchor that is similar to a drilling rig, and the space end of the cable will be attached to an asteroid.
- The elevator cars would be powered by a laser on the Earth-side anchor station. Each car would be equipped with solar panels that could convert the lasers light into energy that would then drive the car up the cable in much the same way that a monorail operates, except vertically [3].
- It also slated for use in the development of solar sails. These lightweight devices use the pressure of the sun lights reflection to push the spacecraft forward. They would solve the issue of having to pack extra rocket fuel aboard the craft before launch, making these new sails a very weight-restricting and cost-effective prospect.

II. SPACE FLIGHT AND NANOTECHNOLOGY

Researchers are looking into the following applications of nanotechnology in space flight:

- Employing materials made from carbon nanotubes to reduce the weight of spaceships like the one shown below while retaining or even increasing the structural strength.
- Using carbon nanotubes to make the cable needed for the space elevator, a system which could significantly reduce the cost of sending material into orbit. Nova has a nice video explaining the concepts.
- Including layers of bio-nano robots in spacesuits. The outer layer of bio-nano robots would respond to damages to the spacesuit, for example to seal up punctures. An inner layer of bio-nano robots could respond if the astronaut was in trouble, for example by providing drugs in a medical emergency. For more about this see page 30 of this report on Bio-Nano-Machines for Space Applications.
- Deploying a network of nanosensors to search large areas of planets such as Mars for traces of water or other chemicals. To read more about this, see page 27 of this report on Bio-Nano-Machines for Space applications [2].

III. ADVANTAGES OF NANOTECHNOLOGY IN SPACE

- Using carbon nanotubes to make the cable needed for the space elevator, a system which could significantly reduce the cost of sending material into orbit.
- This should reduce the weight and complexity of thruster systems used for interplanetary missions.

IV. DISADVANTAGES OF NANOTECHNOLOGY IN SPACE

When tackling the advantages and disadvantages of nanotechnology, you will also need to point out what can be seen as the negative side of this technology:

- Included in the list of disadvantages of this science and its development is the possible loss of jobs in the traditional farming and manufacturing industry [4].
- Since these particles are very small, problems can actually arise from the inhalation of these minute particles, much like the problems a person gets from inhaling minute asbestos particles.
- Presently, nanotechnology is very expensive and developing it can cost you a lot of money. It is also pretty difficult to manufacture, which is probably why products made with nanotechnology are more expensive.

V. ISSUES IN SPACE NANOTECHNOLOGY SOLUTION

Molecular manufacturing creates several severe risks, and each risk tempts a simple and extreme solution. However, a patchwork of extreme solutions will be both destructive and ineffective. For example, Bill Joy and others have proposed halting nanotechnology research entirely. This would not actually work; instead, it would relocate the research to less responsible venues. The risks might be delayed by a few years, but would be far worse when they appeared because the technology would be even less. Molecular manufacturing (MM) creates several severe risks, of several different types [5]. For example, risks may be political, economic, or personal. Even within a single category, opposite situations may create risks. If incredibly cheap manufacturing drives down prices, economies may be disrupted.

VI. CONCLUSION

Compared to traditional materials, nano materials promise an impoved degree of control of the material's structure, enabling improved performances, or the development of new break trough materials. While great progress has been made on engineering nano structured materials, the degree of control that nanotechnology promises is not yet fully realised. There is an immediate need for improved characterization techniques, which will lead to a better understanding of nano materials. This list of top priorities was assembled using the results from TN2; the feedback received from space industry experts at the Round Table and industry and academic literature. A top-level ESA-format roadmap has been prepared to show the TRL level for all of these priorities. An individual roadmap was also prepared for each area, which is connected to a General Activity Description (GAD).

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