Military Uses of Nanotechnology – Risks and Proposals for Precautionary Action

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General Thoughts

Even though the need to study the societal implications of nanotechnology (NT) is being stressed by the U.S. NNI as well as the EC NT programme, observers notice a considerable lack of such research. Military uses of these revolutionary technologies have been studied even less.

Armed forces prepare to overcome the will of an opponent by violent force, using (nearly) any advantage available, new technology being at the centre for highly industrialised states. Anticipating technology use by opponents, the task of the military brings about a tendency to transcend limits of civil society – not only concerning profitableness, but also with respect to rules and behaviour. Secrecy aggravates the problem.

Military NT Applications

For an overview of potential short- and medium-term military NT uses, one can look at the military research and development (R&D) in the USA. Possibilities in the long term can be derived from anticipated technology development. Military work started in the 1980s with sub-micrometre electronics, then scanning-probe microscopes became a focus; in 1996, nanoscience was named one of six strategic areas for defence. In the National NT Initiative, the defence share has grown from $70 million (of $270 million total) in 2000 to $201 million (of $710 million) in 2003. Much of this work is basic science and engineering, carried out at military laboratories and universities. For faster transition, the U.S. Army has founded in 2002 the Institute for Soldier Nanotechnologies at the MIT, which is working on protective battle suits, sensors for body status, exoskeletons, and medical technologies. Considering the convergence of NT, biotechnology, information technology, and cognitive science, national-security goals include uninhabited combat vehicles, warfighter systems, enhanced human performance, brain-machine interface.

Potential future military NT applications span a very wide range: immensely faster and smaller computers, software with everyday knowledge and natural-language capability, very small and cheap sensors, stronger but lighter materials, more efficient energy storage and propulsion. More specifically, improvements can be foreseen in camouflage, armour, penetrators, precision munitions and missiles. Macro and micro robots with and without weapons will become possible, including bio-technical hybrids (e.g., electrode-controlled insects or rats) and small satellites for manipulation of space objects. Concerning chemical and biological weapons (CBW), NT will on the one hand allow capsules for safer enclosure and targeted release of agents, selective reaction with specific genetic or protein patterns, and measures to strongly reduce the risk to the own side. On the other hand, NT is enabling detectors for chemical or biological agents that are much faster, cheaper, more sensitive and selective, as well as materials for better agent neutralisation.

Whether the visionary concept of goods production by self-replicating universal molecular assemblers can be realised, is disputed at present. If it could, exponential growth of armament production would be possible. Also, new weapons types on all scales from molecule to ship would have to be expected, attacking information systems, equipment/infrastructure, biological systems, and particularly NT-based weapons of the adversary.

Preventive-arms-control Considerations

When judging potential military NT uses under criteria of preventive arms control, several of the more generic areas pose no big problems or are too close to civilian uses to consider limi-

tation (e.g., computers). Of the specifically military applications, very few could have positive effects (e.g., sensors for CBW verification). Most, however, raise serious concerns. Existing arms-control agreements can be undermined: the Biological Weapons Convention by new, genetically selective agents, the Treaty on Conventional Armed Forces in Europe by new weapons outside of the treaty definitions. The international law of warfare is at risk by autonomous fighting systems not reliably recognising non-combatants or combatants hors de combat. Destabilisation is probable with omnipresent sensor nets, micro robots, and autonomous weapons. Arms races are to be expected in all areas of military NT use, including countermeasures and counter-countermeasures. Proliferation of technologies, knowledge, and complete systems is likely, not only to other countries, but also into civilian society. Humans and society could be affected by micro robots used for eavesdropping and spying, or for terrorist and other criminal attacks. Indirectly, civilian barriers against non-medical body manipulation could be circumvented by implants in soldiers' bodies, to achieve faster reaction, a wider sensory spectrum, or better communication and control.
In summary, there are good reasons to devise and implement preventive limits. Taking into account that the technology leader will not keep a monopoly for long, such limits should be in the enlightened national interest of the USA, too.

Proposals for Precautionary Action

Because of the fundamental nature of NT and the potential of misuse also in civilian society, limits and verification of compliance should encompass both, the military and civilian realm. Several steps of analysis and action are recommended.

- Detailed studies for the various military NT areas, including preventive limits.
- Special studies: feasibility of visionary NT (molecular assemblers, nanorobots in the body), feasibility of NT-enabled micro nuclear weapons.
- Investigation of verification means and methods for specific NT limits.
- Increased transparency of NT R&D.
- Unilateral and co-ordinated restraint in military NT, in particular for offensive uses.
- Co-operation of the NT initiatives of various nations in R&D, arms control, safety rules, and societal implications.

The upcoming technologies such as NT, genetics, robotics, and pervasive computing are so powerful that to contain their risks, far-reaching limits with intensive verification and potent criminal prosecution will be needed, on levels similar to those that have evolved within civilian society. It is difficult to conceive of such a system internationally in a world where security is mainly built on the threat of armed force. Long-term security thus calls for strengthening of law and political institutions on the international level, including international criminal law, reducing the dependence on national military forces.
The European Union is demonstrating the success of this approach. Given its focus on civilian technology and problem-solving, Europe may be in a good position to include the major (future) actors in military NT in discussions about preventive limits.

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Further references (see http://www.ep3.ruhr-uni-bochum.de/bvp):
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