

10. NATO 179 STCMT 05 E - THE SECURITY IMPLICATIONS OF NANOTECHNOLOGY Lothar IBRÜGGER (Germany) III. MILITARY USES OF NANOTECHNOLOGY 13. While most of the debate over NT focuses on its prospects for informatics and medicine, potential military applications of NT lack proper public attention, despite the fact that NT is becoming increasingly important for military strategists. The funding of military NT makes up a substantial share of total NT funding. 14. The United States is the leader in military R&D of NT. Indeed, the US military has been engaged in this field since the 1980s, focusing on ultra-submicron electronics and scanning-probe microscopy. In 1996, NT was established as one of six strategic research areas for defence. Accordingly, between 25 and 30% of the US National Nanotechnology Initiative funding has gone to the US Department of Defence (DoD) since NNI's establishment in 2000. In 2005, the DoD is due to receive \$276 million for NT, while the Department of Homeland Security will receive an extra \$1 million for this purpose, accounting for approximately 28% of the total US NT budget. The US military R&D is focusing on the development of miniature sensors, high-speed processing, unmanned combat vehicles, improved virtual-reality training, and enhancement of human performance. 15. The UK Ministry of Defence (MOD) is also engaged in military R&D of NT, and allocates approximately £1.5 million per annum to this purpose. However, the MOD considers NT development in the United Kingdom as being driven by commercial, rather than military imperatives. NT related expenditure accounts for 0.35% of the annual UK defence scientific research budget and is substantially smaller than that of the Department of Trade and Industry. Sweden has invested €11 million over 5 years in military NT R&D. The European Union had budgeted €65 million in 2004-2006 to enhance the European industrial potential in the field of security research. Even though this does not specifically mention NT, some of the areas might contain NT implications. 16. Most of military NT is still in R&D level. According to Dr. Jürgen Altmann, one of the most prominent researchers of military NT, it will take between 5 and 20 years or more for the applications of this research to arrive. One can expect that NT-based soldier-worn systems will be introduced in the mid-term future. In 2002, the Institute for Soldier Nanotechnology (ISN) was created at the Massachusetts Institute of Technology (MIT), with a five-year grant of \$50 million from the US Army. The goal of this research centre is to greatly enhance the protection and survival of the infantry soldier, using NT to create a bulletproof battle suit. US army planners are hoping to lighten the load that soldiers carry into battle. These systems could also monitor the state of health of the wearer, improve stamina and reaction, ease or even heal injuries, improve communication abilities, and increase soldiers' protection against biological or chemical weapons. 17. Potentially, NT could dramatically improve warfare technology. Lighter, stronger, heat resistant nanomaterials could be used in producing all kinds of weapons, making military transportation faster, strengthening armour and saving energy. Qualities of nanomaterials can be used for better camouflage. 18. A significant breakthrough in electronics, encouraged by NT, could result in the creation of smaller but very powerful computers, very small sensors and other devices that could be used by the military in a number of ways. Information could be stored and analysed more efficiently, intelligence and surveillance capabilities could be increased considerably by using nanosensors, precision of projectiles could reach extreme accuracy, communication systems could become much more sophisticated, as well as virtual reality systems for training. Tiny sensors or even nanocomputers could be embedded in various military items, munitions, projectiles or uniforms, thus making them "smart". Some more futuristic visions even foresee development of autonomous fighting robots and military use of artificial intelligence, enabled by the development of NT. 19. It is debatable whether NT could bring significant changes to nuclear weapons, as the laws of physics would still require a critical mass of uranium or plutonium. NT, however, might be used to improve arming or triggering systems of nuclear weapons. On the other hand, Dr. André Gsponer, Director of the Geneva-based Independent Scientific Research Institute, argues that NT can actually contribute to miniaturisation and safety of nuclear bombs, by offering heat- and radiation- resistant materials. Furthermore, NT might be used to create the fourth-generation nuclear weapon, i.e. a low-yield "clean" fusion-fuelled nuclear bomb, which would contain no, or very little, fissionable material. These nukes could potentially be used in earth-penetrating missiles. 20. The potential for NT innovations in chemical and

biological weapons is particularly disquieting, as NT can considerably enhance the delivery mechanisms of agents or toxic substances. The ability of nanoparticles to penetrate the human body and its cells could make biological and chemical warfare much more feasible, easier to manage and to direct against specific groups or individuals. Dr. Sean Howard, in his work on NT security implications, has even called the threat of chemical and biological warfare a “real nano goo”. 21. On the other hand, NT offers tools to effectively and profoundly strengthen homeland security policies, aimed at fighting the proliferation of biological and chemical weapons. Sensitive, selective and inexpensive NT-based sensors and materials could detect and bind components of chemical, biological or radiological weapons on the atomic or molecular level, thanks to the large surface/volume ratio of nanoparticles or of nanoporous material (JA). This is very important, as some agents can be lethal even in minuscule quantities. Chemical and biological defence systems with nanosensors could be placed in public places, such as schools or government buildings, public transportation systems, military assets, and border-crossing sites. Finally, nanomaterials could also be used to decontaminate places or individuals affected by chemical or biological weapons. 29

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