BOOK REVIEW

Military Nanotechnology

Potential applications and preventive arms control, by Jürgen Altmann.

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This book, if a little dry, provides a comprehensive review of nanotechnology and its potential military application. The book splits nanotechnology into a number of areas and reviews the potential benefits that might accrue in military applications. It is somewhat unfortunate that the possibility of nanotechnology enabling the manufacture of a small fusion or fission bomb of a few kilotons is discounted early on, but reappears as a possibility in almost every chapter.

There is an excellent review of the potential military market, research spending, and which institutions are researching what, based mostly upon 2002 data. The understandable secrecy surrounding much of the military research has resulted in a rather unbalanced survey, wherein the openness of United States has provided most of the data. Europe and Russia are represented, but the effects of military censorship are apparent in the lack of detail in the data compared to that from the USA. The predictions of Drexler and Kurzweil are reviewed and form the backdrop of the potential applications that nanotechnology will enhance. The dominance of commercial rather than military-based research is noted, and both the US and Europe are observed to have changed tack from defence instigating pure research to application of the results of research pursued by civilian universities and commerce.

The US has published the funds allocated to universities for research aimed at military applications and from this it has been possible to deduce the military priority. Examples where nanotechnology is expected to provide real improvement are: aerosol-based explosives with greater yield, soldier research providing protective clothing, wound repair capability, and active camouflage, robots and autonomous vehicles. In Europe the military appear to rely more on commercial progress with little overt funding, the exception being Israel.

The prospect of molecular nanotechnology (MNT) whereby bottom-up self-assembly of many articles from a molecular base of raw material is possible using a personalized nano-factory, originally described by Drexler, is reviewed but discounted for the time being on the basis that no current military research is really aimed at producing such a nano-factory.

The timescales for the implementation of some military applications are estimated, and following Moore's law, by 2025 micro-computers are expected to be more powerful by four orders of magnitude than today's PCs. This continued reduction in size and cost will enable programmable computing to be embedded in all military applications, from battlefield systems to an individual soldier. It is not strictly a military application, but the estimate is that a

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computer with processing power at the lower limit of the human brain, some 10^{16} operations per second, will be available at then, and that the Turing test (for a computer to have a conversation with a human for five minutes without the human realizing it is a computer) will be passed by 2020. New materials such as amorphous composites with greater strength and flexibility will also be available around then, as will biologically-inspired smart materials that react to their environment. Such materials will form the basis of protection and camouflage for vehicles and soldiers, but there is no mention of negative refractive index materials potentially providing invisibility.

Guns and ammunition made from composites and thus undetectable by conventional scanners are perceived in 5 to 10 years, which would present a real terrorist threat. Dramatic improvements in solar cells are seen in 5 to 10 years, while brain implants to improve soldier reaction time and hybrid animals with electronic control are seen as 10 to 20 years away. In the nuclear field, nanotechnology is not expected to yield major improvements, and the prospect of micro fusion or fission bombs is not perceived as a reality. However, antimatter containment might enable a reduction in size of the fission detonator of a fusion bomb. Biological weapons with or without genetic engineering are probably going to be one of the main beneficiaries of nanotechnology. In many ways these are terrorist weapons of preference and perhaps of most concern. Much is made of MNT and the possibility of manufacturing bio-weapons or non-metallic conventional weapons by terrorists, although this appears not to be a part of contemporary military research.

The remainder of the book concerns the ethical and moral issues in trying to contain nanotechnology, so that terrorists or rogue military states are unable to cause major destabilization of the world. The precautionary principle is favoured whereby limits are set before damage occurs when military nanotechnology proliferates into the wrong hands. Thus it is proposed that potentially damaging nanotechnology should be limited and controlled before it reaches the point where the product becomes dangerous to the public, i.e. avoidance of the "asbestos débacle". In the medical field such limits already exist at a national level in some countries but not globally.

There is a view that terrorists will depend upon the high-technology nations to produce weapons they require and will acquire them illegally. This may be an over-simplistic analysis since recent events with bio-weapons such as ricin and anthrax have demonstrated that these can be produced locally without the need to steal from a technologically advanced nation. The problems of regulation are well explained and the difficulties of separating useful civilian applications and those modified for military purposes defined; an example is micro-size robots for examining human internal organs and the same robot used by the State to monitor individuals.

Various issues are raised in the consideration of arms control, such as how to counter the banned technology within the benign state without conducting research into that technology? Then there is the question of who polices the policeman (the benign state). The principle of humanitarianism is proposed whereby certain obvious technologies with only military applications should be limited, i.e. antipersonnel mines and dum-dum bullets. In a system of autonomous military robots, it is proposed that there would have to be a human in the loop to prevent an autonomous war.

The book ends with various proposals for the regulation of military nanotechnology. These might be laudable but seem somewhat naive against the backdrop of current usage, especially by the USA. Consider for instance the banning of military armed robots; the US and Europe are already using remotely piloted vehicles armed with anti-tank missiles. The ban on non-metallic guns and ammunition might be feasible although against the background and lobbying power of the American National Rifle Association, one might wonder whether it is possible. Medical applications such as implants and cell repair are probably adequately covered by national ethical rules and guidelines, but a global policy is required. The bio-weapons are perhaps the most difficult to tackle although to some extent they are already covered by the Biological Toxin Weapons Convention of 1972, but the problem here will be detection of misuse when all that is required is a small laboratory capable of being set up in individual's house.

Finally, the author notes that the USA is the main problem, it is outspending the rest of the world on military nanotechnology research by a factor of four, yet purports to be the benign state acting as the world's policeman, but shows no sign of self-restraint, at least under the present administration.

In conclusion, this is a book full of facts and speculation, clearly pointing out the problems of nanotechnology in military applications in the wrong hands and identifying some embryonic potential regulation possibilities.

G.C. Holt