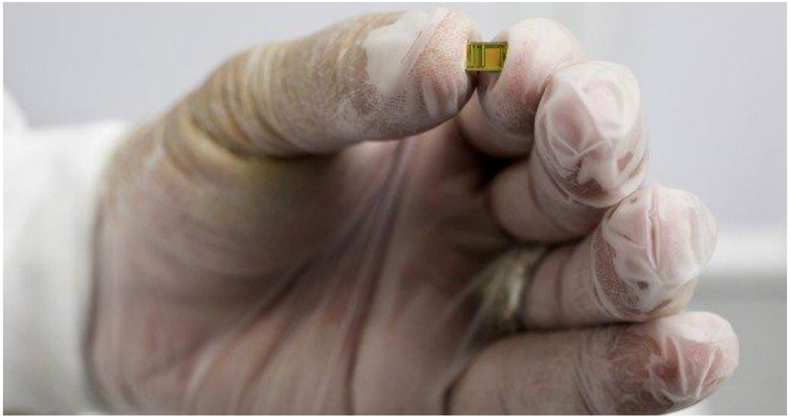
What does nanotechnology mean for geopolitics?

By Nayef Al-Rodhan



Nanotechnology is less than four decades old and has already affected fields as diverse as consumer goods, weapons and therapeutic procedures. As it promises to revolutionize industries and accelerate convergence of sciences and disciplines, it's also bringing about societal and geopolitical shifts.

A nanometre is a billionth of a metre. A human hair is about 80,000-100,000 nanometres wide. The manipulation of matter at this scale offers innovative tools toexpand the limits of what is possible, allowing for the creation of new materials or the modification of existing ones. At the nanoscale, the properties of materials can differ fundamentally from their characteristics at the macro scale. For example, despite weighing one-sixth as much as steel, carbon nanotubes are 100 times stronger.

The incremental development of nanotechnology and its transformative capacity are not without national security implications. Recognizing its enormous potential, the federal government of the United States established the National Nanotechnology Initiative in 2000 in order to maximize coherence of research and development (R&D). The initiative supports the infrastructure to develop nanotech "for the public good".

Why nanotech matters for geopolitical competition

As an enabling technology, nanotech can improve or revolutionize industries such as electronics, IT, energy, oil industry, environmental science, medicine, homeland security, food security, transportation and many more. The role of the US as the still-uncontested world leader in nanoscience will be put to test as numerous European countries, China, South Korea, Thailand, Japan and others are devoting more and more funding to nano research.

China's investments in nano R&D have increased by over 20% each year in the past decade. An understanding that a boost in sciences is critical for future competitiveness has led the Chinese government to provide an extra stimulus package in 2009, with over £12bn reserved for R&D. In 2011, Russia, Korea and Singapore launched the Asia Nanotechnology Fund, which recognized that "nanotechnology is a key enabler technology for many sectors, providing for tremendous growth opportunities".

Hundreds of commercial products now rely on nanoscale materials and processes; the market share is estimated to be between $50 billion and $1 trillion. Although commercial forecasts vary, it is without doubt that nanotech is increasingly critical for national power, a premise which follows from both current and potential military applications of nanotech.

The US Department of Defence identified nanotechnology as one of the six strategic research areas in the mid-1990s, and in recent years, emerging or so-called "re-emerging" powers have increased their investments. With the use of nanotechnology, Russia has already successfully developed the world's most powerful non-nuclear bomb, with a blast radius of 300 meters and the ability to contain the equivalent of 44 tons of explosives (the US bomb is equivalent to 11 tons).

Seven state capabilities

The correlation between nanotech and national security is often limited to applications of nanotech in the military (and the extent to which it can redefine technological asymmetries on the battlefield). It is, however, crucial to understand that the repercussions of nanotechnology on geopolitics and national power are more far-reaching. In a previous work, *Neo-Statecraft and Meta-Geopolitics*, I advocated a "meta-geopolitical framework" that is more suitable for our globalized, connected and interdependent world. In this, I suggested that national power is best described in terms of seven key state capabilities:

1. **Social and health issues** – Nanotechnology can have enormous implications in medicine and therapeutic procedures by improving diagnostics and providing better and faster cell repair. Nanorobots injected to fight cancerous cells can provide targeted drug delivery and make repairs at the cellular level (and potentially even correct failing organs). TheDNA nanocage, designed from the body's own molecules, is developed to "trap" diseases at the molecular level. "Nanosponges", tiny polymer nanoparticles, could absorb toxins while removing them from the bloodstream. Gold nanoparticles could be used to detect early-stage Alzheimer's disease. The breakthroughs in nanomedicine will provide us with unprecedented control over the human body and will simultaneously raise social and ethical debates.

2. **Domestic politics** – Nanotechnology could offer both new platforms for better (and more intrusive) surveillance as well as more efficient technologies for domestic security and emergency response. For example, certain nanomaterials could be employed for creating better sensors that detect hazardous materials and nanorobots could be used to deactivate bombs.

3. **Economy** – Nanotech is relevant for fields such as agriculture, where nanosensors could monitor crop growth or detect plant pathogens. It has already been in use for many electronics and it provides smaller, faster and more energy-efficient systems. Nanoscale transistors, for instance, are not only smaller, but also faster and more powerful than their conventional counterparts. To boost their oil industries, states are now looking into the potential of using nanoparticles of silica to make oil extraction faster and cheaper.

4. **Environment** – Some of the hype around nanotech has focused on its potential to reverse environmental degradation: nanostructured filters and smart nano-materials could purify water or detect contamination. Furthermore, nanotech could have beneficial applications for battery-recycling processes, provide solutions for oil spills and improve the efficiency of solar panels through the incorporation of nanoparticles in solar-panel films.

5. **Science and human potential** – A distinct feature of nanotech research has been the convergence with other fields, such as biology, material science, cognitive science, chemistry, engineering, etc. This convergence has generated dynamic interdisciplinary exchanges and the emergence of fields that integrate nanotech with other fields, including nano-medicine, nano-manufacturing, nano-electronics etc.

6. **Military and security potential** – Some of the most groundbreaking innovations in the defence industry rely on nano-enabled applications, which span the different phases of military operations. Examples include nanostructures for invisibility cloaks for concealing soldiers, vehicles or weapons; a wide range of smarter and more devastating weapons; and, with the use of carbon nanotubes, lighter and stronger armour and vehicles. Nanotech could also change the future of communications through microscope computers, help develop high-power lasers, or help improve soldiers' uniforms, by incorporating thermal, chemical and biological sensing systems.

7. **Diplomacy** – Nanotech will significantly alter the nature of warfare and weaponry, including nuclear weapons, with inevitable consequences for disarmament diplomacy. The tendency towards increased miniaturization, nano-engineered high-explosives, high performance sensors and many other devices will require new negotiations of standards of arms controls and compliance with international law.

Another consequence of nano-enabled miniaturization and heightened precision on the battlefield will be that some of the political costs of war will be reduced. Soldiers will be better protected and civilian casualties (presumably) minimized. At the same time, the use of nano-technologies with highly destructive potential will exacerbate asymmetries and complicate post-war reconciliation or relations between countries.

From everyday commercial products to diplomacy and war, nanotechnology is set to be a highly transformative and consequential technology for the decades to come. In the early 20th century, Halford Mackinder advanced his notion of "the pivot of history", the idea that whoever commanded the pivot area of the heartland commanded the world. Such geopolitical thinking is now obsolete but we can use this analogy to reflect on the future relevance of nanotechnology and other similar disruptive and transformative technologies. Given its immense potential to affect different state capabilities, R&D of nanotechnology will be critical for national power.

Transnational geostrategic competition in this field is increasing exponentially, and although the US is currently at the forefront of nanotech R&D, it's uncertain how long it can continue to maintain its status of absolute global leadership over the "science of small things".

Author: Nayef Al-Rodhan is an Honorary Fellow at St Antony`s College, University of Oxford, and Senior Fellow and Head of the Geopolitics and Global Futures Programme at the Geneva Centre for Security Policy. He is the author of The Politics of Emerging Strategic Technologies, Implications for Geopolitics, Human Enhancement and Human Destiny.

This article was originally published on the *World Economic Forum* website on June 23, 2015.
https://agenda.weforum.org/2015/06/what-does-nanotechnology-mean-for-geopolitics/