

A conversation with Eric Drexler on October 8th, 2014

Participants

- Eric Drexler – Academic Visitor, Oxford Martin Programme on the Impacts of Future Technology, University of Oxford
- Nick Beckstead – Research Fellow, Future of Humanity Institute, University of Oxford

Note: This set of notes was compiled by Nick Beckstead and gives an overview of the major points made by Dr. Drexler.

Summary

Nick spoke with Eric Drexler in order to learn more about atomically precise manufacturing and related potential philanthropic opportunities.

What is the problem?

It can be argued that it will eventually be possible to implement nanosystems capable of programmable, high-throughput, atomically precise manufacturing. However, there are widespread misconceptions about the nature and in-principle feasibility of such systems, R&D projects are generally focused on shorter-term issues, and there is little coordinated effort toward developing these systems. Without a change in these perceptions and research directions, atomically precise manufacturing would not be developed for a long time. However, if there were a wide enough agreement about development pathways and enough funding were available, it would be hard to rule out developing atomically precise manufacturing within ten years of establishing a well-funded, well-focused, and well-structured research program.

People who are watching the field and know what to look for would be unlikely to be caught off guard even by rapid developments in atomically precise manufacturing. While development could be surprisingly fast, it would be possible to observe the substantial advances in various capabilities of nanosystems (e.g., mechanical stiffness of various types of nanostructures, number of moving parts of mechanical systems, and lattice sizes of materials used to build intricate systems) that would come before the technology reaches its mature form. Hypothetically, surprise could come if there were a secret project aimed at developing the technology, but that would be implausible in the present climate.

What could a philanthropist do?

Convene meetings that would promote development of atomically precise manufacturing.
In the short term, a philanthropist could organize meetings aiming to:

- Assess the feasibility of advanced atomically precise manufacturing,

- Assess proposed development pathways toward atomically precise manufacturing (especially “soft” pathways involving structural DNA nanotechnology and self-assembly of biomolecular materials), and
- Create a roadmap which would mobilize people and resources to develop atomically precise manufacturing.

Support would be needed to provide funding for such meetings and to find someone willing and able to organize the meetings, manage the creation of reports following the meetings, and promote the findings of the reports. If successful, these meetings might establish the feasibility of nanosystems with general (macroscale) manufacturing capabilities, clear up misconceptions about the technology, build support for specific “soft” development pathways, and mobilize people and resources toward the development of atomically precise manufacturing.

There have been roadmapping efforts and assessments related to atomically precise manufacturing in the past, but they did not lead to these results. One feasibility assessment was conducted in 2006 as part of the Triennial Review of the US National Nanotechnology Initiative. At the time, there was a widespread hostility toward atomically precise manufacturing, especially from leaders of the nanotechnology community in Washington DC, and there was pressure first, to prevent the study, and then for the study to report a negative conclusion. Citing his book *Nanosystems: Molecular Machinery, Manufacturing and Computation*, the assessment found no fundamental problems with Dr. Drexler’s technical analysis of the feasibility of atomically precise manufacturing, but said that such analysis cannot be conclusive, in particular with respect to the reliability and thermodynamic efficiency of the nanosystems described by Dr. Drexler. The report recommended funding further research on the technologies, including the pursuit of implementation pathways. However, this recommendation was removed from the executive summary of the report and received little attention.

A roadmapping report was made in 2007, sponsored by The Waitt Family Foundation, Batelle, the Foresight Institute, Sun Microsystems, and Zyvex Labs, in conjunction with several of the US National Laboratories. This roadmap had little visible impact, perhaps because it wasn’t sponsored by the right institutions and lacked key, influential participants, and because its recommendations were diffuse and weren’t strongly promoted. Future meetings and reports would need to avoid these failings. Today, Dr. Drexler would propose a substantially different and more focused roadmap that centers on concrete lines of development.

If these proposed meetings were successful, philanthropic funding would probably not be necessary to support the development of atomically precise manufacturing because the work could be supported by mainstream funding sources.

Current and future potential for policy-oriented research

Significant efforts to promote policy-oriented research related to atomically precise manufacturing would be premature prior to more credible and widely accepted assessments of the feasibility of the technology. In the absence of more widespread acceptance of central ideas related to atomically precise manufacturing, this research would have little immediate impact.

In the medium term, if the central ideas related to atomically precise manufacturing gain more widespread support, a philanthropist could support policy-oriented research on issues posed by atomically precise manufacturing. Advanced atomically precise manufacturing has the potential

for an extraordinary range of beneficial applications, but would also enable the development of new and powerful weapons. As we now have academic institutions doing policy-oriented research on nuclear policy, in the future, we may want to have academic institutions doing similar policy-oriented research on issues related to atomically precise manufacturing. Some of the questions such research could address would be analogous to issues related to nuclear policy, and some would be distinctive. Dr. Drexler and Dennis Pamlin discussed some of these issues in “Nano-solutions for the 21st century.”

People to talk to

Andrew Turberfield, Professor of Physics, University of Oxford

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