Nanotechnology pioneer slays 'grey goo' myths

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Eric Drexler, known as the father of nanotechnology, today publishes a paper that admits that self-replicating machines are not vital for large-scale molecular manufacture, and that nanotechnology-based fabrication can be thoroughly non-biological and inherently safe. Talk of runaway self-replicating machines, or “grey goo”, which he first cautioned against in his book Engines of Creation in 1986, has spurred fears that have long hampered rational public debate about nanotechnology. Writing in the Institute of Physics journal Nanotechnology, Drexler slays the myth that molecular manufacture must use dangerous self-replicating machines.

“Runaway replicators, while theoretically possible according to the laws of physics, cannot be built with today’s nanotechnology toolset,” says Dr. Drexler, founder of the Foresight Institute, in California, and Senior Research Fellow of the Molecular Engineering Research Institute (MERI). He continued: “Self-replicating machines aren't necessary for molecular nanotechnology, and aren’t part of current development plans.”

The paper, Safe Exponential Manufacturing by Chris Phoenix, Director of Research of the Center for Responsible Nanotechnology, (CRN) and Dr. K. Eric Drexler, also warns that scaremongering over remote scenarios such as “grey goo” is taking attention away from serious safety concerns, such as a deliberate abuse of the technology.

Phoenix said: “Runaway replication would only be the product of a deliberate and difficult engineering process, not an accident. Far more serious, however, is the possibility that a large-scale and convenient manufacturing capacity could be used to make powerful non-replicating weapons in unprecedented quantity, leading to an arms race or war. Policy investigation into the effects of molecular nanotechnology should consider deliberate abuse as a primary concern, and runaway replication as a more distant issue.”

In 1986, Drexler described a powerful manufacturing system. This “assembler” would use robots the size of bacteria to join individual molecules into products. Assemblers would be highly productive, because small things can move quickly. The products would be precise and strong because molecules are small and uniform, and form strong bonds.

For all these reasons, this idea was attractive. However, Drexler also described a danger scenario. A robotic molecular manufacturing system could be directed to build a copy of itself. If someone built a tiny, self-contained manufacturing system that had all the directions for building a copy of itself, and had all the equipment needed to use biomass as raw materials, and could move around, then the system could self-replicate and spread. If it had no built-in limits, then this complex system could, in theory, lead to a worst-case scenario of runaway replicators, popularly called grey goo.’

Science fiction writers focused on this idea, and ‘grey goo’ became closely associated with nanotechnology, spreading a serious misconception about molecular manufacturing systems and diverting attention from more pressing concerns. This new paper shows why that focus is wrong.

The authors explain why self-replication, contrary to previous understanding, is unnecessary for building an efficient and effective molecular manufacturing system. Instead of building lots of tiny, complex, free-floating robots to manufacture products, it will be more practical to use simple robot-arms in larger factories, like today’s assembly lines. A robot-arm pulled from a factory would be as inert as a light bulb pulled from its socket. And the factory as a whole would be no more mobile than a desktop printer, besides requiring a supply of purified raw materials to build anything. Even the process of developing the factories would not make anything

remotely like a runaway replicator - the early machines would be tools, unable to operate by themselves.

The paper can be downloaded here: Drexler Paper