Nanotechnology

Figure 1: (Sonia Zjawinski, Kenn Brown, Wired)

> *The Tao can't be perceived.*
> *Smaller than an electron,*
> *it contains uncountable galaxies.*
> *- Tao Te Ching, S. Mitchell translation*

Biological nanotechnology using programmed biobots (bacteria running genetic programs) have been around for 70 years, producing everything from microprocessor components to medical probes. Mid-century "hard" nanotech was developed. It requires extreme vacuum and weightlessness to function properly, but can assemble many atomic structures with high precision. This resulted in the development of many ultra-strong or smart materials, effective nanocomputers and a myriad kind of tiny robots. The third nanorevolution is underway with artilife, which is essentially a mixture of biology and nanotechnology.

As a rule, the price of anything goes up the higher the density of "smarts" there is. Diamond can be made in bulk cheaply, smart paint and micromachine dust is affordable, medical nanomachines and nanocomputers are very expensive (per weight, but a little goes a long way).

Nanofacturing

In principle nearly any kind of solid object can be constructed, but the time and effort is often too large. Building things with nanotechnology is most cost-effective for small, intricate objects. Nanofacturing is hence mainly used for nanocomputers, smart dust and special ultra-high performance materials. For larger objects various forms of fabbing and automated assembly are

used: micofacs produce parts or building blocks that are assembled by meso- and macrofacs. Still, people like to refer to their home assembler as a nanofac, although it is merely a glorified 3D printer.

Smart dust

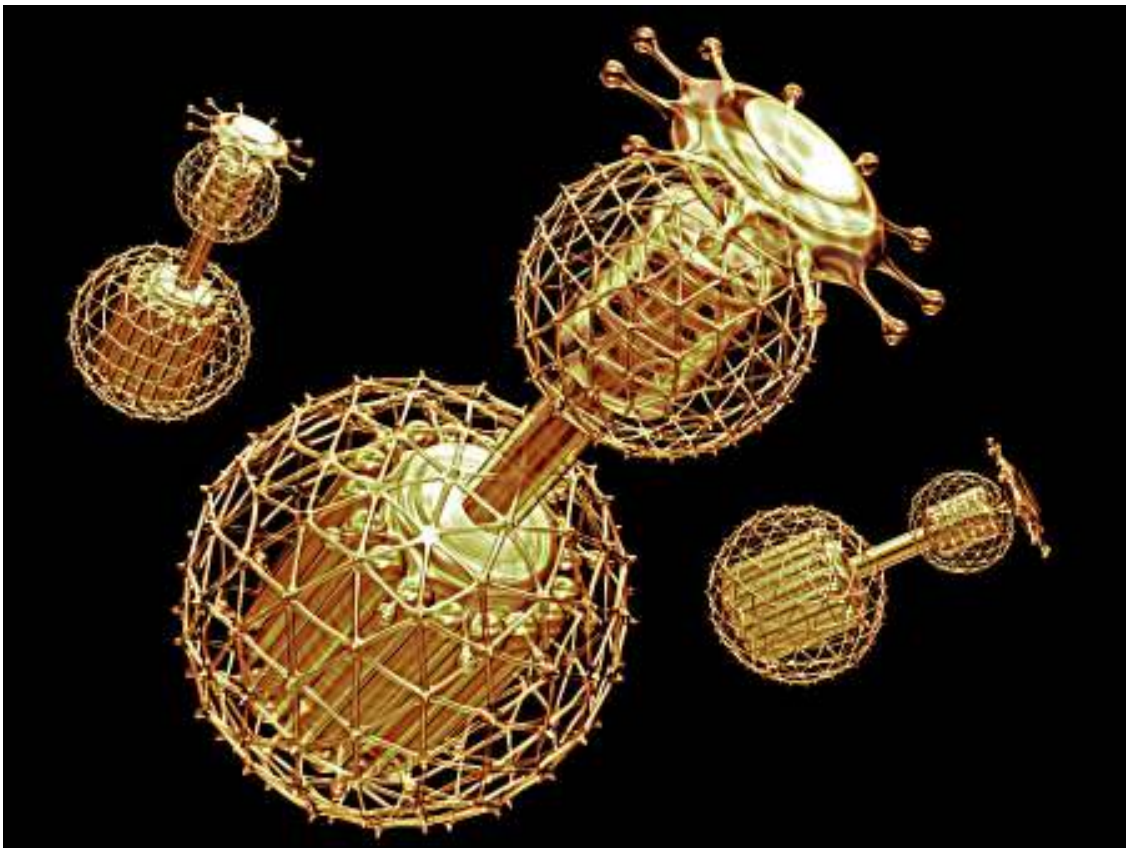

Figure 2 (Mondolithic Studios)

Micromachines equipped with sensors and communications systems. Practically everpresent in space, where it helps monitor the integrity of habitats. Different kinds of smart dust detect physical data (pressure, temperature, radiation, vibrations, light), chemical data or biological data. Together they give not just a good picture of what is going on, but allow ubiquitous surveillance.

On Earth smart dust was common before the Spamocalypse. In particular eco-monitoring dust was common in the oceans, on land and in the atmosphere. Unfortunately this ad hoc network was ideal for infiltration by the dragons, and became a major spam hotspot. It was deliberately destroyed during the restoration and has not been replenished.

Claytronics ,"Smart mud"

An aggregate of smart matter that can change shape and color, acting as an universal gizmo or a simple haptic interface. It consists of microscopic modules that can move relative to each other. While a bit too weak to make real tools or structures intended to bear any serious load (at best, it

is like plastic), it is perfect for toys, models, decorations, impromptu screens or user-interfaces. Many people use claytronic tablets to manipulate their data, touching it rather than seeing it.

Diamond

Macroscopic diamond nanosynthesis is possible but too expensive to use for large constructions. Instead nanofactured diamondoid seeds are produced, and them polymerized into massive diamond.

Burning goo

An interesting application of nanomachines is emergency action. Burning goo is not so much activated as ignited: it uses one-time pyrotechnic resources to power vigorous chemical activity. The principle is a bit similar to oldfashioned airbags. It is mainly used for damage mitigation in spaceships when seriously damaged or emergency sealing in habitats.

Nanoimmune systems

Figure 3: Disruptor spray, used to immobilize active nanomachines (Joshua Davis)

Although nanoimmune devices were developed to deal with the Dragons, they arrived too late and were too inefficient in the messy environment of the biosphere. In space they are much more useful to protect and guard space habitats. Most habitats in Earth orbit have a layer of

nanoimmune devices to deal with spores and infiltrating machinery. There are also specialist immune devices that can be used against certain targets, e.g. plasmids or surveillance machinery.

Artilife is gradually subsuming the role of nanoimmunity, especially since it is cheaper to make self-replenishing. There is some concern however that it will be less reliable – many nanoimmune systems are provably safe, while artilife is too complex to formally test.