

ClinicalRM
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in developing
FDA-approved
diagnostic assays.

Also read our technical notes on related topics:

- Alternatives to Antibiotic Use
- PCR Techniques
- Resistant Pathogens

REFERENCES

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NANOTECHNOLOGY IN MEDICINE & BIOTECHNOLOGY

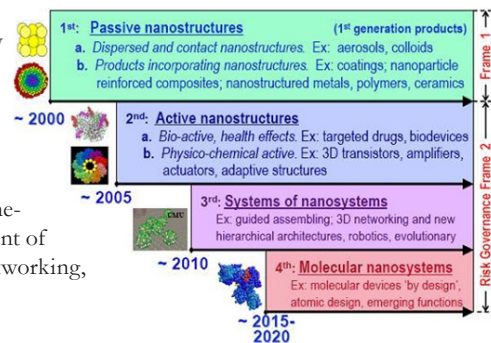


Nanotechnology is defined as the manipulation of matter and structures at atomic and subatomic scales. Since the term was popularized by Eric Drexler in the early 80's, nanotechnology has been used in products like cosmetics and sunscreens in its passive form. It is expected that in the coming decades, new phases of products, including improved batteries and electronic equipment, will be developed and have far-reaching implications.

As nanotechnology became an accepted concept, the meaning of the word shifted to encompass all types of nanometer-scale technology. The U.S. National Nanotechnology Initiative was created for funding; their definition of nanotechnology includes anything smaller than 100 nanometers with novel properties. This agency has been at the forefront in accelerating nanotechnology advances and development.

Nanotechnology development has been slated to evolve through four phases or generations, which are depicted in the graphic on the left. The current development stage is related to the refinement of active nanostructures and to the development of new guided assembly systems incorporating 3-D networking, robotics, and evolutionary technologies.

■ Sachin Mani, Ph.D.



IN THE FIELD...

ClinicalRM employees, especially those working at the Walter Reed Army Institute of Research (WRAIR), have been on the cutting edge of infectious disease research – including the development of novel vaccines that utilize nanotechnology. An example of this work is the development of nanoparticle based polypeptide vaccine against Malaria. This vaccine is comprised of an icosahedral nanoparticle composed of 60 polypeptide chains that act as B cell epitopes, resulting in the generation of a robust protective antibody response.

Another example involves the development of improved diagnostic assay platforms for infectious disease agents that use colloidal gold and nanobiosensors. ClinicalRM employees at WRAIR have been instrumental in developing FDA-approved diagnostic assays for malaria, Dengue, and Scrub Typhus.

APPLICATIONS

The realm of medicine is one area of nanotechnology that has promise of providing society with great benefits. Some potential applications include:

1) Developing Effective Diagnostics for Infectious Diseases with Nanotechnology

Nanoparticles like colloidal gold and quantum dots are being used extensively to increase the sensitivity of pathogen detection assays. Nanotechnology is also being used to develop novel tracking systems for infectious disease in the blood and had lead to better diagnostics tools such as ELISA, ELISPOT, and nanoparticle based biosensors.

2) Developing Vaccines Using Nanotechnology

Nanoparticle based vaccines use nanostructures to present immunogenic antigens, peptides, and proteins on nanoscaffolding. Novel vaccines for viral, bacterial, and protozoan agents using nanotechnology are in development; examples of these include the recombinant Dengue vaccine and the novel protein based vaccine against Malaria.

3) Nanotechnology Used in Drug Delivery Systems

Nanotechnology is used as the basis for new, more effective drug delivery systems and is in early stage development as scaffolding in nerve regeneration research. Moreover, the National Cancer Institute has created the Alliance for Nanotechnology in Cancer in the hope that investments in this branch of nanomedicine will lead to breakthroughs in the detection of, diagnosis of, and treatment of various forms of cancer.

In coming years, medical developments in nanotechnology will have a wide variety of uses and could potentially save a great number of lives. Targeted drug therapies or “smart drugs” have allowed nanotechnology to progress from use in passive structures to active structures. These new drug therapies have already shown to cause fewer side effects and be more effective than traditional therapies. Future uses of nanotechnology may aid in the formation of molecular systems that could be strikingly similar to living systems and may prove to be the basis for the regeneration or replacement of body parts that can be lost to infection, accident, or disease. These predictions have great significance, not only in encouraging nanotechnology research and development, but also in determining a means of oversight. The number of products approaching the FDA approval and review process is likely to increase as time progresses and as new medical applications are developed.