

**NEXGEN RESTORATIVE HEALTH CARE THRU SYNTHETIC BIOLOGY AND  
NANOSCIENCE**

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Recent advances in our ability to manipulate matter at the scale of individual molecules have created an incredible level of excitement in both the scientific community and the general population. The excitement over this new capability, commonly labeled nanotechnology, is vested in the expectation of the development of new materials and systems that offer unparalleled functionality. Materials that autonomously adapt their shape and physical properties in response to their surroundings, computers that instead of operating by switching the flow of electrons, manipulate information through the management of the ethereal world of quantum states and, molecular sized machines that actively repair damage to our bodies and function as molecular scale prosthetics are all expectations of nanotechnology. While the question of whether or not this vision is truly achievable is still open, the truth is that much of the expectations for nanotechnology are already realized in living systems.

Living systems however, are more than a product of matter manipulation at the molecular scale; the richness of functionality associated with living systems is a direct product of the information generated from both the interactions between molecules and the overall supra-molecular structure of the system. In essence living systems are “living” because of the fusion of nanotechnology and informatics. Living systems result from the precision assembly of matter with prescribed modalities for the transport and transduction of information among supra-molecular clusters.

Recent advances in surgical and diagnostic tools emanating from nanotechnology will be presented in the context of Integrative Technology. Integrative Technology is the intersection of the precision assembly of matter, nanotechnology, coupled with the functional building blocks of nature, biotechnology, fused by the network flow of spatiotemporal information, informatics. The power of Integrative Technology is illuminated through the creation of Synthetic Biological Systems. Hybrid biotic/abiotic systems that enable the restoration of lost biological function thru designed communication among supra-molecular assemblies. Illustrative examples will be presented that include the engineering of muscle-powered Biobots and the creation of nano-sized excitable vesicles with the ability to intrinsically process information. These devices have the potential of replacing lost biological function in physiologic structures such as the Sinoatrial node or damaged neurons, and highlight a new modality for disease therapy. Technology that will expand surgical applications beyond the arena of structural repair to the realm of physiological manipulation.