Nanostructures and Biology – Some Introductory Remarks

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The following collection of material is an introduction to cross-disciplinary efforts centering on the study and control of living systems. Cross-disciplinary interactions in the field of biology are not new. Mendel's work in genetics was a fusion of biology and the mathematical science of statistics. The structure of DNA was the result of a successful merger of chemistry, biology and the physics of x-ray diffraction. The fruits of molecular biology are evident in the plethora of new drugs and medical treatment approaches emerging today. The cell is, perhaps, the paradigm for the "nano-machine," demonstrating the richness of function available in the macromolecular world. In fact, textbooks exist from the early '90s on microstructures in biology (ref.1).

So the question here is: what's new? What will the National Nanostructure Initiative (NNI) offer us in enhanced capability? Obviously, increased funding "breeds" more activity. And the cross-disciplinary nature of the NNI effort plays naturally into an already on-going plan of research. The NNI can serve as a facilitator, through its workshops and conferences, to further strengthen this level of interaction. In some sense, the NNI "legitimates" the cross disciplinary approach to science and serves to nurture it.

What we would like to emphasize here is the unique benefit nanostructural science and technology offers to biology. The issue revolves around what those of us in electronics would term the "contact" problem. We would like to be in direct, physical contact with the inner mechanisms of the cell. This contact could serve actively or as a passively. In the passive role, nanostructures would be local sensors of chemical constituencies or physical parameters, such as temperature or pressure. In the active sense, nanostructures could physically manipulate the contents of the cell. These sensors or actuators must obviously be tiny.

We feel that current research in nanostructure science and technology has a definite slant to the types of sensors and actuators required to address the "contact' problem. Many of the papers and reports to follow carry through with this theme, showing how nanotubes as well as traditional microelectronic devices specially engineered for in vivo or in vitro operation, should serve to drive biology into new areas. Or course, the link between "biosensors" and military technology is obvious in light of recent world events.

Reference

1. J. M. Schnur and M.C. Peckerar, eds., **Synthetic Microstructures in Biological Research**, Plenum Press, New York, 1993.

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