Nanobiotechnology and Metrology

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The potential benefits of applying nanoscience knowledge to biological systems at times seem boundless. Tumor "seek and destroy" nanoparticles, comprehensive and early diagnostic methods and artificial scaffolds to encourage neural growth are but a few of the possibilities.

As with any great opportunity, there are also challenges and risks; this is especially true for man made nano entities with biological uses.

Dealing at the nanoscale is currently a challenge for any application. Areas of work include fabrication, reliability and quality assurance, statistical analysis, uniformity, measurement techniques and non invasive/destructive testing and accurate measurement tools. Many of these areas are topics of study at NIST and other institutions as well as the subject of this workshop.

Although precision at the nanoscale will be required for many applications – the precision needed may border on perfection when the created nanoscale object has a biological or medical application. How critical are uniform dimensionality, coating composition, continuity and material purity for the intended application and what are the allowed tolerances, if any?

Once we address these issues in general and even perhaps for biological applications specifically, we are still left with the issue of the "unknown" target – a complex, living organism for example.

The last decade has led to astounding discoveries in the areas of biology and medicine, often aided by powerful computers and nanoscale tools. We are beginning to understand how biological systems operate and interact. It is this new understanding of biological relationships that causes a geometrical growth in the possibilities for things to go right or for things to go wrong. We have a long way to go before we understand the complexity and interactions of biological systems. The recent understanding of certain drug responses of patients based on their ethnic background is a case in point.

This compounding of issues (nanoscale metrology and biological interactions) will lead to a requirement for integrated and dependent work by multiple organizations. What is determined in the biological arena in terms of interactions and purity requirements, for example, will drive the metrology requirements for nano entities with biological uses. It will require a conversation between medical researchers –as they define what needs to be measured and what tolerance values are allowed – and metrology and equipment specialists defining what can be measured and at what precision. As has occurred many times over the decade, nanoscience will once again require that the left hand knows what the right hand is doing.