Guest Editorial

New uses for gold in the emerging field of nanotechnology

Nanotechnology may be defined as the production of useful devices, sensors or materials by assembling molecules or individual atoms into artificial, nano-scale structures. The field of nanotechnology contains elements of physics, chemistry, engineering and even biology. Gold is one of the materials that is frequently used or proposed for nanotechnology applications. In recognition of this trend, the forthcoming "Gold 2003" conference, to be held in Vancouver in October, will include pioneering sessions dedicated to the use of gold in nanotechnology.

Matter behaves rather differently at the nanoscale. For example, interatomic interactions and factors that are quite unimportant at macro-scales become dominant, and the values of many material parameters change markedly. Phenomena at the nano-scale lay, for the most part, out of experimental reach until the latter part of the twentieth century. However, the development of various kinds of scanning probe microscopes, as well as ultra-high resolution transmission and scanning electron microscopes, and the publicity accorded the field by prominent individuals such as the Nobel laureate physicist Richard Feynman and writer Eric Drexler, has provoked a concerted international interest in the nano-scale.

The interesting heterogeneous catalytic ability of gold is intimately linked to its properties at the nano-scale. Nano-particles of gold exhibit special properties and an unusual electronic configuration which renders them catalytically active.

Why is the nano-domain of such intensive interest to researchers at many of the world's top technological companies? Because it offers a way to make a huge leap forward. Whether in medicine or computer technology, nanotechnology offers a way to break some frustrating bottlenecks in current technology. There is unfortunately a lot of hype around nano-devices and nanotechnology. However, there is also considerable optimism, based on quite sober considerations. The US, Japanese and EU governments have earmarked significant funds for nanotechnology research, in an expectation of meaningful returns!

Why would gold have any special role to play in nanotechnology? There are at least three reasons. The first is that only a noble metal like gold is capable of serving in the un-oxidised state at the nano-scale. Most less noble metals will be oxidised to a depth of a thousand nanometers or more, in many cases obliterating the nanoscale component. So designers of any nano-device requiring metallic components are likely to consider gold favourably. Secondly, due to its nobility, gold offers a unique surface chemistry that allows it to be used as a platform on which to self-assemble layers of organic molecules, usually bound to the gold by carefully placed sulphur atoms. Such "self-assembled" structures may be used as sensitive biomedical or chemical sensors. Finally, gold is readily fabricated at the nano-scale by electrolytic or electroless deposition and may be further modified by straightforward extensions of existing lithographic technologies.

Manufacturers will use, gold when it provides the best technological performance. A $20 medical test kit or sensor might contain only 50c of gold and yet it may be this critical ingredient that makes the whole device possible. These issues and others besides will be discussed at the "Gold 2003" conference.

See you in Vancouver,

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