Gold Nanoparticles for Physics, Chemistry, and Biology

"*If someone sold you gold that is non-relativistic, you made a bad deal because you were sold silver …*" This light-hearted remark in a talk by Uzi Landman captures the special position the element gold occupies in our periodic table and also in our history and culture. Some of the unique attributes of gold, when compared to other noble metals, indeed arise from relativistic effects on its electronic structure. If it were not for such relativistic effects, gold would not possess its characteristic yellowish luster; rather, it would resemble silver, the metal with a similar electron density. To add to its charm, gold, unlike its periodic table neighbors, silver and copper, has an exceptionally high chemical stability against corrosion, oxidation, and sulfidation and can stay untarnished for decades.

In the last two decades, the nanoscale version of gold has been attracting attention in laboratories throughout the world. In fact, "nanogold" can be considered to be one of the poster childs of nanoscience and nanotechnology with many of its properties dramatically different from its bulk counterpart. For instance, the metallic luster of bulk gold gives way, on the nanoscale, to brilliant size- and shape-dependent colors, originating from localized surface plasmon resonances of free electrons in the nanoparticle. Relatively inert in its macroscopic version, gold in the nanocluster form exhibits a catalytic activity that has intrigued scientific and industrial communities alike. *Gold Nanoparticles for Physics, Chemistry, and Biology* is a book that captures the tremendous scientific interest and research activity in gold nanoparticles that we have witnessed in recent times. Last year alone, over 7000 papers appeared on the topic of gold nanoparticles in areas ranging from optical engineering to molecular biology, making a compendium on this research topic quite useful. While the book consists of thirteen chapters, many of them written by topical experts, fortunately, it does not read like a mere survey of disparate topics in the field, thanks to a well-balanced selection and ordering of content.

Chapter 1 introduces the reader to the rich history of gold nanoparticles. It serves as a good reminder that some ideas of nanoscience have existed since the time of Michael Faraday. In fact, the physics behind the brilliant colors of nanoparticles has been known for over a 100 years.

Chapter 2 provides a well-written introduction to the chemical and physical properties of gold. I wish the chapter were more detailed and that later chapters utilized some of the concepts introduced in the chapter.

Chapters 3 and 4 educate the reader about the most important set of physical properties of gold nanoparticles, i.e., their optical and photothermal response. The inclusion of non-linear optical properties and field-enhanced light–matter interactions, e.g., surface enhanced Raman scattering, would however have been desirable.

Chapters 5 and 6 survey bottom-up synthetic methods for preparation of a diverse range of gold nanostructures, both in colloidal form and on solid supports. This content will serve as a source of synthetic recipes; however, the reader should not expect to develop a conceptual foundation necessary for mechanistic insight, or rational ideas for designing new syntheses.

Chapters 7, 8, and 9 provide a description of the intriguing catalytic, surface, and electronic properties of gold nanoparticles, clusters, and islands. These chapters are my personal favorites, especially since there is a lot more to be understood in these areas and also because new phenomena discovered in gold nanoparticles can serve as a model for nanoscience in general. An entire book could be dedicated to these topics alone.

Chapters 10, 11, and 13 cover the technological applications of gold nanoparticles, with a particular focus on potential uses in biomedicine. Some of this content feels more like a survey, which may not be entirely avoidable. With the possibility of technological adoption of gold nanoparticles, their potential toxicity and environmental concerns need attention, which are addressed in Chapter 12.

The book by Louis and Pluchery, I believe, can serve as a comprehensive source of knowledge for a new academic or industrial researcher looking for an introduction to this decades-old yet exciting field. However, readers may find the book lacking in conceptual or technical depth, which likely resulted from the need to cover the breadth of the field. Secondly, several recent developments do not receive attention: for instance, the plasmon-assisted photocatalytic properties of gold nanoparticles, which has become a hot topic in the last few years, or the synergistic attributes of hybrid materials containing gold nanoparticles, a sub-field in its own right. The field of gold nanoparticles remains a broad and fast-moving one and can be difficult to keep up with; however, this is certainly not an unwelcome problem for new or existing researchers, Louis' and Pluchery's audience.

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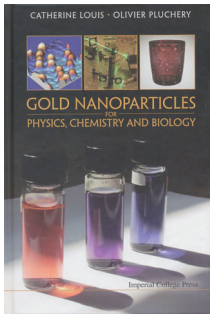

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