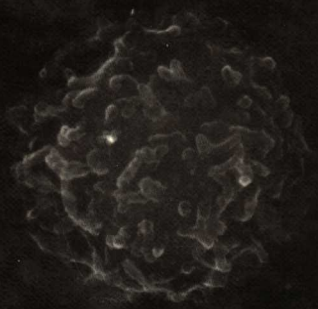
Colloidal Gold

Principles, Methods, and Applications



Volume 1

M. A. HAYAT

Colloidal Gold

Principles, Methods, and Applications

VOLUME 1

Edited by

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Preface

The field of immunogold cytochemistry–histochemistry is a relatively recent development, but has emerged as a revolutionary new immunocytochemical methodology for various microscopic systems. In 1971, Faulk and Taylor inaugurated the use of colloidal gold as an immunocytochemical marker in transmission electron microscopy. Since that time, immunoelectron microscopy using colloidal gold promises to advance morphological, as well as virological, diagnosis by a quantum leap.

The major objective in using colloidal gold is the *in situ* localization of cellular macromolecules. This information is used to elucidate biochemical properties and functions of cellular compartments and components. The method is universal since it is applicable to photon and fluorescent microscopy and conventional and high-voltage transmission electron microscopy and can also be employed as a marker for scanning electron microscopy in the secondary electron and backscattered electron modes. It is useful for scanning transmission electron microscopy. Thin cryosections can be labeled with colloidal gold. The silver-enhanced colloidal gold method can be used for both light and electron microscopy.

Multiple labeling of the same specimen or section is applicable not only to light and transmission electron microscopy but also to scanning electron microscopy in the secondary and backscattered electron imaging. Simultaneous demonstration of more than one type of antigen can also be accomplished on thin cryosections by the immunogold method. These applications

are possible because colloidal gold particles ranging from 2 to 150 nm in diameter are available. Although postembedding labeling is most common, the technique can be used for preembedding immunolabeling. Many other significant applications are discussed in detail in this three-volume treatise.

Since the number of available techniques is quite large and new techniques and refinements of established techniques are continually being developed, it is clear that a set of books was more appropriate than a single volume. Volume 1 emphasizes principles and methodology, whereas Volumes 2 and 3 stress methodology and applications.

Colloidal gold as a marker meets many requirements necessary for precise ultrastructural localization, distribution, and quantitation of macromolecules in living or fixed cells and tissues. Adsorption of macromolecules to gold particles is not based on chemical covalent crosslinking but on complex electrochemical interactions. Most bound macromolecules therefore essentially retain their biological activity. Colloidal gold has been adsorbed to a wide variety of molecules including proteins A and G, immunoglobulins, lectins, toxins, glycoproteins, dextran, enzymes, streptavidin, and hormones. This approach has proven to be extremely useful in basic and applied research. Localization of enzyme activity with immunogold staining has also become popular. Colloidal gold labeling can be quantitated, and an approximation of the relative density of antigenic determinants at different sites can be made. During the last decade, scientific literature involving the use of colloidal gold as the immunocytochemical marker has increased at an exponential rate, and this trend is expected to continue.

In spite of the unparalleled superiority of colloidal gold over other markers, its efficiency and specificity need to be carefully evaluated and improved. This is the only way to strengthen this methodology and to place it on a firmer foundation. To examine the accuracy of this methodology, the morphology and structure of colloidal gold and silver ascertained with high resolution electron microscopy are presented in Volume 1. Molecular interaction between colloidal gold and proteins is explained to help understand the principles governing this methodology. Factors affecting the staining with colloidal gold are discussed, and advantages and limitations of this methodology are given.

Volume 1 also discusses a large number of variations of the immunogold methodology. Methods are presented in maximum detail and step-by-step fashion, so that the reader could carry them out without other assistance. It is suggested that the whole procedure be read before carrying it out. If any problem arises, the reader need not hesitate to contact the author of the method. Both commonly used and special methods are included. It is important to emphasize that the authors have personally used and checked the methods, which are therefore reproducible.

Volume 1 has developed through the effort of 24 scientists representing 8 countries. All of the contributors are eminent authorities in their respective fields of specialty. In fact, many are the originators of important methods. The scientific community is fortunate to have the benefit of continual expansion and refinements of the colloidal gold methodology by most of those who primarily originated it. I greatly appreciate their participation and promptness in completing the chapters. I owe thanks to J. M. Cowley, D. A. Handley, M. Horisberger, A. Howie, and M. V. Nermut for their valuable comments on some of the chapters.

M. A. Hayat

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