CHARACTERIZATION OF INDIVIDUAL GOLD NANO PARTICLES FOR BIO-MEDICAL APPLICATIONS

A.T.M. Lenferink, L. Hartsuiker, W. Petersen, S. Manohar, C. Otto
Medical Cell BioPhysics, Faculty of Science and Technology, University of Twente,
MIRA Institute for BioMedical Technology and Technical Medicine.
Building Carré, room CR4538
P.O. Box 217, 7500 AE Enschede, The Netherlands
E-mail : a.t.m.lenferink@utwente.nl

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1. INTRODUCTION

Gold nano particles are of interest for bio medical applications because of their favorable optical and chemical properties. We have adapted an optical microscope to integrate dark-field microscopy with fluorescence microscopy and Raman microscopy. This microscope enables to find and characterize individual gold nano particles and observe the optical response in spectral time traces. For excitation we used a 647nm line of a ArKr-laser
For the characterization we prepared GNR's having dimensions of 40 by 60 nm with a Peg-layer to avoid clustering. Highly diluted solutions of these GNR's in water were mixed with a low concentration agarose gel solutions and were slowly dried-in on a microscope slide. The achieved thin layer (1~2 microns) made it possible to observe single GNR's with the microscope, and create spectral image by means of a raster scan imaging technique.
The adapted homemade LED-dark-field option on our microscope made it possible to observe the single GNR's in the thin gel layer with video speed. In the more dense areas of the gel where GNR's form huge clusters, the spectral fluorescence response measured showed it's earlier observed broad banded character. But going towards the edge of the layer where the GNR's are more dilute the separated small clusters or single GNR's seemed to show a different more narrow banded response. The broad banded response of the big clusters seems to be composed of an ensemble of more narrow banded responses of single or small cluster GNR's. Also the distribution of Single GNR spectra does not appear to be random but seems to have at least 3 to 4 preferable band positions.
Imaging the GNR's by raster scan technique with powers around 1 mW showed that beads where not able to withstand these powers. During imaging or when GNR's are under a continues spectral time trace measurement, the GNR shows a non stable spectral emission. It shows rapid (< 20ms) abrupt changes in spectral response. It's mostly characterized by a stable period in the beginning of the measurement, where there is a slow drift of the fluorescence band toward the longer wavelengths, followed by a period of fast spectral changes. Another phenomenon observed while monitoring the single GNR's fluorecense in time, was a visible Raman scattering or even surface enhanced Raman scattering (SERS). Also this, only visible at rare moments and fluctuating rapidly and mainly showing only a part of the Raman spectra expected to originate from the near surrounding of the gold bead.