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Production of unimodal size distribution nanoparticles by low pressure plasma, and illustration of their potential use in medecine

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Because of their interesting optical, electronics, magnetic, mechanical and structural properties, production of well-dispersed metallic and non-metallic nanoparticles with controlled size and shape is increasingly necessary to improve technological and medical applications. Among all methodologies used today to synthesize nanoparticles, one can cite vacuum technology to produce spherical non-agglomerated nanoparticles through a vapour phase approach by DC magnetron sputtering at high pressure. The idea was introduced for the first time by Takagi et al. in 1972 and was improved few years later by the use of inert gas condensation methodology based on magnetron sputtering which has the advantage of producing high-purity atomic vapour from a wide variety of solid materials or composites.
In this lecture, we will describe how this technique can be used to produce metallic and non-metallic nanoparticles such as Ag, TiO_2, Au, Y, C, Zn, ZnO, Fe and Co and polymer based nanoparticules. If time allows, results and an explanation about nucleation and growth processes will be also given for each cases.
Finally, we will focus on the Au case for which we will discuss the properties of nanoparticules produced by gaz aggregation technique. Medical application of Au NP will also be illustrated by a selected example from our group about the production of antibody-functionalized gold nanoparticles to selectively target cancer cells as well as probing their potential radiosensitizing effects under proton or X-ray irradiation. We will describe Au NP production, bioconjugation with monoclonal antibody, in vitro and in vivo cyctotoxicity, and quantitative assessment of dose response relationship of several hundreds of bioconjugate-injected mice exposed to proton or X-ray beams.

Keywords
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