# Voltammetric Characterization of Gold-Based Bimetallic (AuPt; AuPd; AuAg) Nanoparticles

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Bimetallic nanoparticles are nowadays some of the most promising materials for catalytic, electrocatalytic and electroanalytical applications thanks to their novel optical, catalytic, magnetic, and sensing properties. Such novel features, often different and enhanced with respect to the monometallic counterparts, make these systems good candidates to be conveniently applied in a wide range of fields. The possibility to obtain different kinds of bimetallic composites (in terms of composition, structure, metal loading, morphology, etc.) goes in parallel with the need of powerful and accurate characterization tools. Among the commonly involved techniques like Optical Spectroscopy and Dynamic Light Scattering (DLS), also the more powerful Transmission Electron Microscopy (HR-TEM) and Extended X-Ray Absorption Fine Structure (EXAFS) are widely used. However, these analytical tools present some drawbacks in terms of high costs and low accessibility. In this context, electrochemistry and particularly Cyclic Voltammetry, is here proposed as an alternative, low cost, easy to use and simple characterization technique.

The possibility to use electrochemical methods to study the final structure of bimetallic nanocomposites was already demonstrated in the Literature [1-2], but there is still lack of information on how such systems change and evolve in time and after aging periods. Therefore, Cyclic Voltammetry is here used, as a complementary technique to HR-TEM and EXAFS not only to investigate the structure of alloyed or core-shell gold-based (Au-Pt; Au-Pd; Au-Ag) systems (by studying the quantity and type of metals present in the materials), but also to elucidate the evolution and growth in time of such bimetallic samples. Time evolution characterization allows to control the morphology and to fix it at the desired point.

Finally, the characterized gold-based nanocomposites are used in electrochemical sensing and electrocatalytic applications. A strong improvement in the response, in terms of higher peak currents and electrocatalytic effects, of the bimetallic systems with respect to the monometallic counterparts is evidenced, due to the intimate contact between the two metals, which is responsible of synergistic effects. Also, the effects of an eventual carbonaceous support on the properties of the metal nanoparticles and the possible synergistic effects between composites and supports are investigated [3].

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