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Shape and stability of silver nanoparticles and their dependence on the conditions of preparation.

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ABSTRACT

By using the citrate reduction procedure we have synthesized Ag nanoparticles, applying several conditions of preparation, being after characterized by UV-visible spectrophotometry. Following a logical sequence, the starting experiment was realized varying the reaction time, after that it was varied the concentration of the reductor agent, and finally it was varied the volume of the reductor agent. According to this methodology, TEM measurements show that firstly we have nanostructures with different shape and size, whereas in the last part of the experiment we have Ag nanoparticles with homogeneous shape and size.

INTRODUCTION

Silver nanoparticles have been object of interest, due the potential applications in several fields as photography [1], catalysis [2], biological labeling [3], photonics [4], optoelectronics [5], information storage [6], surface-enhanced Raman scattering [7] and drug delivery [8]. In general, the optical properties of nano-structured materials are strongly related to their shape. This is particularly true for silver and gold nanoparticles due to the strong surface plasmon oscillations within these metals [9]. As a result, a variety of optical properties such as peaks in absorption, significant-enhancement in Raman scattering intensity and non-linear properties can be found by varying the shape of the particles. Some reports have been devoted to the synthesis of silver nanoparticles with different shapes. This includes zero-dimensional spherical or tetrahedral quantum dots [10], one-dimensional silver nanorods and wires [11], and two-dimensional nanoplates [12]. The preparation of silver nanoparticles in suspension by chemical reduction is usually performed by using silver nitrate as the starting Ag salt, which is reduced by a chemical reducing agent to produce colloidal suspensions integrated by nanoparticles with variable size depending on the method (generally between 10 and 80 nm). The most frequently used reducing agents are trisodium citrate [13] and sodium borohydride [14]. In general, the use of a chemical reducing agent has the advantage of the feasibility and rapid preparation of the colloidal suspension together with the higher stability of the suspended nanoparticles. This stability is due to the absorption of the counterions of the salts employed in the colloid preparation, which confers a high electric charge to the nanoparticles.