CHAPTER I

INTRODUCTION AND AIM OF THE THESIS

Nanocomposite materials consisting of dispersed metal nano clusters in a matrix of insulating material show extraordinary physical properties and have been proposed for optical [1,2], electrical [3] and medical applications [4] as well as for data storage [5]. These properties of the composites are very sensitive to small changes in the amount of metal and in the size and shape of the nanoparticles. This sensitivity leads to drastic changes in the electrical and optical properties of the material, which can thus be used as sensors or switching devices. Polymers are a good choice, as a matrix, for the metal nanoparticles in order to stabilize the particle size and the growth along with easy processability and low-cost fabrication. Different techniques are available for producing such composite films [6].

1. Physical Vapor Deposition (PVD) including the combination of evaporation and sputtering of metals with plasma polymerization [7] as well as magnetron sputtering from a composite target [8] and coevaporation [9,10].
2. Mechanical mixing of the metal nanoparticles with a) monomer followed by polymerization, b) molten or dissolved polymer matrixes [11,12], which often leads to an inhomogeneous dispersion of particles in the highly viscous matrixes.
3. In situ synthesis of metal nanoparticles in polymer matrixes

This thesis work concerns more with one of the metodos above mentioned, that is to say with the in situ synthesis of metal nanoparticles in polymer matrixes, which involves the dissolution and reduction of metal salts/or complexes. A number of metal nanoparticle–polymer composites have been prepared by the chemical reduction of the polymer–metal chelates, such as Au–polyaniline [13], Ag–polyimide [14] and Cu–poly(acrylic acid) composites [15].

Moreover, a simultaneous polymerization–reduction approach initiated by ultraviolet or X-ray irradiation was also recently employed to synthesize Ag–polyacrylamide [16], Au–PAN [17] and Ag–PAN [18] composites.

Size-selected silver nanoparticle–polyacrylonitrile (PAN) composites have been synthesized by a simultaneous polymerization–reduction approach, providing highly

crystalline silver nanocrystals with a narrow size distribution well dispersed in PAN matrixes [19].

In situ synthesis of silver–epoxy nanocomposites was achieved by visible light polymerization through a simultaneous photoinduced electron transfer and cationic polymerization processes[20-21].

The aim of this thesis work was to modify one of most versatile way to obtain nanoparticle imbedded into polymer matrices in order to better control the physical properties of the obtained Polymer Dispersed Metal Nano Particles (PDMNP) systems. More precisely our main objective was to investigate the possibility to modify the method used in ref 19, by introducing changes in the polymerization route to turn the acrylonitrile (AN) into PAN by assisting the polymerization process by two independent photo activation process: one due the activity of the silver ions itself and another linked to the use of an independent (not linked to nanoparticle generation) activator.

We were primarily interested to obtained PDMNP films with high electron conductivities and with an high optical transparency. This two characteristic can be obtained by finely regulating the sizes of the nanoparticles (silver nanoparticles in our case) and their density into the polymer matrix. We will see in the next chapters that the optical transparency of the film is linked to the absence of Plasmon Resonances into the visible range of EM spectra, and this property is mainly regulated by the nanoparticle sizes. On the other hand the conductivity is linked to the volume fraction of nanoparticles imbedded into polymer matrix. In order to regulate both the size of the particles and their density, the polymerization process of PAN must be controlled not only by the concentration of the silver salt, but also by some other adjustable chemical parameters.

Was also the aim of the work to study the electric and optical characteristic of the produced film

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