Photoluminiscent nanocomposites PS/CdSe (quantum dots) via miniemulsion polymerization

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Abstract

In the present work miniemulsion polymerization was applied to encapsulate CdSe quantum dots in a polystyrene (PS) host matrix to produce photoluminiscent polymer nanocomposites. The latex was characterized by TEM and SEM. Nanocomposite film was characterized by absorption and emission UV spectrometry. Latex particles size ranged between 155 ± 30 nm. Fluorescence spectrums showed a 595 nm peak for an original solution of CdSe (QDs) and the resultant dried material PS/CdSe, suggesting that the polymerization method used preserves the optical properties of the quantum dots. The expectation for these materials is to create a new generation of hydrocarbon sensors.

One of the most promising fields of application for nonostructured materials is that of semiconductors. In recent years, intense research has been developed about a kind of nanoparticles with very attractive electronic and optoelectronic properties, the *quantum dots (QDs).* These are semiconductor nanocrystals with typical size of 1 to 10 nm [1] and represent the ultimate limit of low dimensional structures. In quantum dots, free carriers are confined in all three directions. They are often referred to as artificial atoms because their electronic properties resemble, for example, the ionization energy and discrete excitation spectrum of atoms.

When novel particular materials like quantum dots are envisaged to have strong potential according to their properties, is always interesting to think about their insertion in different matrices for the development of new and functional composites. In this direction, the incorporation of QDs in polymer hosts has been in recent years object of intense research, since it is considered ideal for certain applications [4]. Several strategies have been used to incorporate QDs into polymer matrices, i.e., the simple mixing of the QDs with the polymer, or the covalent or non-covalent bonding of QDs with the polymer. However, the simple mixing of the QDs with the polymer is not good enough due to phase segregation.

In the present study QDs of cadmium selenide (CdSe) of 2 to 3 nm were encapsulated into polystyrene particles of nanometric size. Through encapsulation it was expected to overcome some problems such as QDs phase segregation, chemical instability and compatibility. Miniemulsion polymerization was used as synthesis technique, since it is especially useful to incorporate hydrophobe compounds into polymer particles. The absence of micellar nucleation and the compartmentalization of the polymerization into the mini-emulsified droplets are some of the main characteristics that make this technique especially suitable for this task.