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Review Article

Biocompatible Ophthalmic Layers Synthesized by Sol-Gel Technique for Us in Nanostructured Optical Products with Tuning of Physical Features

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Abstract

The modified optoelectronic equipment with doped nanostructures is a suitable candidate for use in the field of optical and electrical biomedical products. The doped nanostructures support the identical modification with the elimination of toxicity at the cell via the pH-dependent (low pH). The nanostructures (such as nanospheres) play the role of the effective carrier for the targeted delivery of sensitive drugs into the cells.

Keywords: pH; Optical Products; Sol-Gel Technique

Introduction

Biocompatible optical products derived from the sol-gel technique can be used commercially in optical and biomedical applications. Optical products have the preparation capacity with a large variety of products related to ophthalmic *in situ* gels. The optical coatings can be designed with favourable optical, magnetic, mechanical (low friction, abrasion resistance etc.), chemical (barrier for gasses), and electrical properties in optical and biomedical products [1-10]. The sol-gel-based optical products are favourable due to their high chemical homogeneity, low processing temperatures, and the possibility of controlling the size and morphology of particles. The functional behaviour of several ophthalmic products derived by the sol-gel technique has supported the performance of *in situ* gel-forming systems that are instilled as drops into the eye. The durability and functionality of coatings are critically dependent on the adhesion performance between the coating layer and the underlying substrate for use in the nontoxic ophthalmic layers. The synthesis of the optical semiconductor layers is preferred for the integration of the electronic and optical devices (with thicknesses between ~ 10 nm and 1 μm). The transparent conductor layers can be coated by using the sol-gel technique as the transparent conductors are produced commercially at low temperatures in a cost-effective sol-gel coating technique. The sol-gel coating technique is accepted as a useful alternative coating technique with several advantages. It is possible to change the processing conditions with the modification of the synthesis parameters at the coating of the microstructures. The sub-micron thin films with uniform thickness can be derived by using a suitable sol-gel coating technique with respect to the utilization purpose of the product [9,10].

The increasing focus on the manufacturing of nanostructures resulted in the development of various synthesis approaches including chemical, physical, and biological techniques. The various synthesis methods of the nanostructures have supported modifying their size, shape and surface charge in their biomedical applications (such as the application mechanism of nanostructures). The doped nanostructures have supported the development of high transparency (over 90%) and low absorption in the visible-infrared region where electromagnetic waves and atoms displayed the lowest interaction, large band gap (such as ~2 eV) which only absorb high-frequency electromagnetic waves in the UV region and high rectification ratio (suitable rectifying behaviour) with Si [1-8].

Photoirradiation with UV (or NIR) increase its anticancer activity via synergistic chemo-photodynamic effect. The drug delivery applications of the doped nanospheres have controlled release and therapeutic effects [4-6].

The sol-gel synthesis of optical products based on the hydrolysis and condensation of molecular precursors is used to prepare inorganic materials in a wide utilization range. This procedure gives sols, colloidal particles suspended in a liquid that progress through a gelation process. The increase of interest in sol-gel-based biomedical and optical products has paralleled the emergence of their features of unique hosts for a number of biologically important molecules that can be used in several biomedical applications. For optical imaging and biomedical applications, sol-gel technology has made the cost-effective connection of the vast common ground between chemistry and materials science. The main advantages of sol-gel technology are in the chemical adaptation of biomedical materials in the human body. The sol-gel approaches can be used successfully to prepare nano-dimensional inorganic optical products. The optical and biomedical products can be explained in several main research categories such as the studies of silica-based sol-gel materials and non-silica-based materials for the production of various fiberoptic applicators and for laser therapies, sol-gel biological materials improving biocompatibility, porous sol-gel materials in applied biomaterials researches and the optical sol-gel materials [11,12].

The versatility of the sol-gel derived materials has demonstrated the interpenetrating organic and inorganic networks which support the generation of hybrid materials. These materials are based on the use of sol-gel approaches to combine organic and inorganic functionalities. The sol-gel technique will be used to synthesize the advanced adventive materials at the perspectives of the interface of physics and biology. The contributions of physics in sol-gel technique have indicated the active research areas in modern biology searches at the solutions of the complexity in the clinical applications. The optical design with specific optical architectures will enable to obtain of unique properties for the development of futuristic nontoxic ophthalmic layers in clinical applications [13-15].

Developments in biocompatible ophthalmic layers

The nanostructures modified by the doping mechanism have supported the optimum compatibility of the optoelectronic layers at the interface and tune band bending due to their high transparency and carrier mobility. The different peaks of smart materials (developed by nanostructures in the visible region) can trigger light emission at room temperature and their peaks can locate the different regions in the visible spectrum. The doping mechanism of the nanostructure can support the development of optoelectronic materials with low resistivity and high transmittance with the optimum band gap in optoelectronic devices.

The modified nanoparticles by the development of the doping mechanism are used effectively in nontoxic ophthalmic devices with optimum refractive index and suitable optical absorption in the nontoxic ophthalmic layers to improve device performance and enhance internal quantum efficiency. Transparent conductive oxide (TCO) ophthalmic layers including nanostructures are useful to apply in UV-light emitter devices and they have crucial value in the visible range for use in the smart ophthalmic layers [3-8]. The photocatalytic efficiency depends on the type of doped element (such as a catalyst) at the development of the automation process. The nature of the doped element plays a key importance in the service conditions (light power, the surface properties of the catalyst, the concentration of the solution such as pH, etc.) affecting the photocatalytic properties. The nanotexturing supports making the surface biomimicry by using the nature of the doped element and the experimental conditions.

Conclusion

The modified nanostructures have supported high transparency, low growth temperature, and good thermal stability by the doping mechanism at the optoelectronic layers. These properties have provided the development of nontoxic ophthalmic layers with the minimum adverse effects at tuning photonic properties.

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