Study on the Use of Rhodamine Doped Nanocomposite for Latent Fingerprint Detection

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Abstract	Silicon dioxide-based nanocomposites offer large loading capacity for various doping chemicals or molecular complexes, high surface to volume ratio and customizable surface chemistry for the creation and development of novel sensors and devices [1-2]. When compared with other sol-gel materials, xerogels represent a class of nanocomposites that are relatively easy to fabricate but with unique thermal, acoustic, optical and mechanical properties for rapid sensor or device prototyping development [3-4]. Xerogels in solids are formed by controlled evaporation of the liquid in the hydro-gel. Their porosity and morphology depend largely on the temperature, gel chemical compositions and pH in the fabrication process. When impregnated with fluorescent compounds in their nanosize cavities, the doped xerogels exhibit strong and stable fluorescence properties that are useful for the developing of ion-exchange sensors and optical devices. However, the use of these fluorescently doped xerogels in forensic applications was still largely unexplored.

First page example

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Study on the use of Rhodamine doped nanocomposite for latent fingerprint detection

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Keywords: rhodamine B, nanocomposite, fingerprint, detection

Introduction. Silicon dioxide-based nanocomposites offer large loading capacity for various doping chemicals or molecular complexes, high surface to volume ratio and customizable surface chemistry for the creation and development of novel sensors and devices [1-2]. When compared with other sol-gel materials, xerogels represent a class of nanocomposites that are relatively easy to fabricate but with unique thermal, acoustic, optical and mechanical properties for rapid sensor or device prototyping development [3-4]. Xerogels in solids are formed by controlled evaporation of the liquid in the hydro-gel. Their porosity and morphology depend largely on the temperature, gel chemical compositions and pH in the fabrication process. When impregnated with fluorescent compounds in their nanosize cavities, the doped xerogels exhibit strong and stable fluorescence properties that are useful for the developing of ion-exchange sensors and optical devices. However, the use of these fluorescently doped xerogels in forensic applications was still largely unexplored.

Rhodamine B is often used in chemical and biological field as a tracer dye within water or other reagent to determine the rate and direction of flow and transport. Ethanol-based Rhodamine B solution is also used extensively as a fluorescent dye to enhance the deposit of superglue-developed fingerprints in forensic science. However, the potential applications of Rhodamine B doped nanocomposites in forensic science, latent fingerprint detection in particular, were still unclear [5-7]. The use of Rhodamine B doped in silicon dioxide based nanotemplates to form stable fluorescent nanocomposites for the purpose of latent fingerprint detection was the main goal of this exploratory study.

The Rhodamine doped TEOS composite was prepared by sol-gel method. Its detection for latent fingerprints left under different conditions was studied. The results show that the Rhodamine B doped TEOS composite is available for the detection of fresh fingerprints left on most non-porous surfaces, semi-porous and porous surfaces. It is better than the traditional Rhodamine solution method according to its large usage and strong fluorescence.

Experimental

Preparation of Rhodamine doped silicone dioxide-based xerogels

Rhodamine doped TEOS wet gel was prepared by the following general procedure. TEOS (5.8ml, 26.0mmol) was added to a stirred methanol solution of Rhodamine followed by a rapid addition of deionized water (1.15ml). The mixture was stirred for 1 min before being divided into 3ml aliquots in glass vials. The gels were then aged for 5 days at 25℃. After aging the robust gels were washed every 12-18 h with Rhodamine methanol solution for 2 days. After washing the gels were then dried via slow evaporation at room temperature. After 7 days Rhodamine doped silicone dioxide-based xerogel was obtained.

Preparation of magnetic Rhodamine B doped silicone dioxide-based xerogels (MRBX) powder. The Rhodamine doped silicone dioxide-based xerogels were ground into a fine powder using a mortar. Iron powder was added to the xerogel powder with a mixing ratio of 10:1 (w/w). The mixed power was identified as MRBX powder. The MRBX powder was kept in closet vials at room temperature for storage. The fluorescence properties of the powder were found to be stable for more than 12 months. Labeling powders for latent fingerprints detection do not have to be