Journal of Science: Advanced Materials and Devices 2 (2017) 22–33

Contents lists available at ScienceDirect

Journal of Science: Advanced Materials and Devices

journal homepage: www.elsevier.com/locate/jsamd

Original Article

Sonochemically assisted hollow/solid $BaTiO_3:Dy^{3+}$ microspheres and their applications in effective detection of latent fingerprints and lip prints

M. Dhanalakshmi [a, b], H. Nagabhushana [c, *], G.P. Darshan [d], R.B. Basavaraj [c], B. Daruka Prasad [e]

[a] Department of Physics, Govt. Science College, Bengaluru 560 001, India
[b] Research and Development Center, Bharathiar University, Coimbatore 641046, India
[c] Prof. C.N.R. Rao Centre for Advanced Materials, Tumkur University, Tumakuru 572103, India
[d] Department of Physics, Acharya Institute of Graduate Studies, Bangalore 560 107, India
[e] Department of Physics, BMS Institute of Technology and Management, VTU, Belagavi-affiliated, Bangalore 560 064, India

ARTICLE INFO

Article history:
Received 19 December 2016
Received in revised form
31 January 2017
Accepted 9 February 2017
Available online 16 February 2017

Keywords:
Sonochemical synthesis
Latent fingerprint
Cheiloscopy
Judd–Ofelt analysis

ABSTRACT

Nanostructured materials find potential benefits for surface-based science such as latent fingerprints (LFPs) and lip print detection on porous and non-porous surfaces. To encounter the drawbacks viz. low sensitivity, high background hindrance, complicated procedure and high toxicity associated with traditional fluorescent powders were resolved by using hollow/solid $BaTiO_3:Dy^{3+}$ (1–5 mol %) microspheres. The visualization of LFPs stained by the optimized $BaTiO_3:Dy^{3+}$ (2 mol %) hollow/solid microspheres exhibits well-defined ridge patterns with high sensitivity, low background hindrance, high efficiency and low toxicity on various surfaces. The powder X-ray diffraction results revealed the body centered cubic phase of the prepared samples. The emission spectra exhibit intensive peaks at ~480, 575, and 637 nm, which were attributed to transitions $^4F_{9/2} \rightarrow {}^6H_J$ (J = 15/2, 13/2, 11/2) of Dy^{3+} ions, respectively. Surface morphologies were extensively studied with different sonication times and concentrations of the used barbituric acid. The Commission International De I-Eclairage (CIE) and Correlated Color Temperature (CCT) analyses revealed that the present phosphor is highly useful for the fabrication of white light emitting diodes.

1. Introduction

In a crime spot investigation, LFPs are the most important physical evidence for identification of criminals [1,2]. When a criminal touches any surface in a spot, skin sweat transferred to the surface through pores leading to an invisible ridge pattern is well known as latent fingerprints. In a forensic analysis, LFPs are the most influential method due to its unique and immutable features [3,4]. Because of invisibility of LFPs, enhancement of LFPs was required for identification and visualization. Nowadays, several methods have been used to make LFPs visible. Among them, the powder dusting method allows for LFPs to be visualized within a short period of time and without any complicated requirements. The conventional dusting powders were mainly classified into regular, metallic and luminescent materials. Regular and metallic powders constituent of resinous polymers and meshed metals which are hazard to investigators' health [5]. These conventional powders are not capable of enhancing LFPs on some complicated surfaces. Luminescent nanopowders are potential solutions to overtake such limitations, making LFPs visible. Luminescent nanopowders were explored as labeling agents for visualization of LFPs and exhibit good contrast, sensitivity and adhesion efficiency. These factors provide new possible applications of nano powders in surface science.

In addition, lip prints are form of wrinkles and grooves including normal lines, fissures and are present in the zone of transition of human lip between the inner labial mucosa and outer skin [6]. Lip prints are also a main evidence for identification of an individual in a forensic dentistry due to its uniqueness, except in monozygotic twins. The revelation of lip prints was well known as cheiloscopy [7]. The cheiloscopy plays a major role in forensic science for person identification in crime investigations, ethnic studies, mass disasters, fire victims, and vehicle accidents.

* Corresponding author.
E-mail address: bhushanvlc@gmail.com (H. Nagabhushana).
Peer review under responsibility of Vietnam National University, Hanoi.

http://dx.doi.org/10.1016/j.jsamd.2017.02.004