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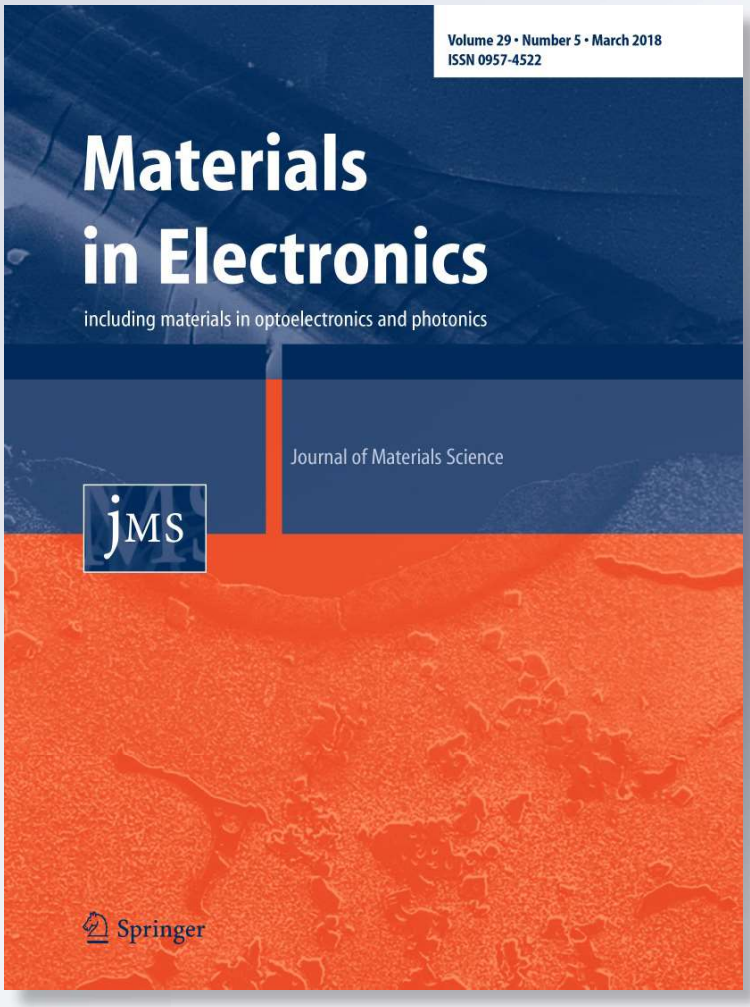
Journal of Materials Science: Materials in Electronics

ISSN 0957-4522
Volume 29
Number 5

J Mater Sci: Mater Electron (2018)
29:4106-4121
DOI 10.1007/s10854-017-8355-7



Springer

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https://doi.org/10.1007/s10854-017-8355-7

UV irradiation induced microstructural changes in $CdCl_2$ doped PVA–PVP blend

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Received: 17 September 2017 / Accepted: 29 November 2017 / Published online: 4 December 2017

Abstract
Films of cadmium chloride ($CdCl_2$) doped polyvinyl alcohol (PVA)–polyvinyl pyrrolidone (PVP) blend were irradiated with ultraviolet (UV) light, of wavelength 254 nm. Modification in band structure of the doped polymeric blend films has been studied using optical (UV–Visible) and fluorescence (photo-luminescence) spectral analysis. On exposure to UV radiation, the PVA–PVP samples doped with $CdCl_2$ from 5.4 up to 12.1 wt% (doping level) get blackened, possibly due to carbonization. Microstructural modifications in these films caused by UV irradiation have been studied with the help of scanning electron microscope (SEM) images. The molecular chemical changes caused by UV irradiation on $CdCl_2$ doped PVA–PVP blend has been studied using Fourier transform infrared (FTIR) and FT-Raman spectra of these films, after UV exposure for 30 and 180 min. The results are compared with those of un-doped PVA–PVP blend films, which have been exposed to UV irradiation for the same time interval.

1 Introduction

Studies on metal salt doped homo-polymers and polymeric blends have assumed importance in recent times, due to their potential applications in the fabrication of batteries, fuel cells and super-capacitors [1–5]. The field of solid polymeric electrolytes has blossomed into an active area of contemporary research on advanced materials [6–10].

The studies on cadmium chloride ($CdCl_2$) doped polyvinyl alcohol (PVA)–polyvinyl pyrrolidone (PVP) blend films using various techniques have been elaborated by us earlier [11–15]. It is to be noted that $CdCl_2$ doped PVA–PVP polymeric blend films show an increase in degree of crystallinity, in the doping range (doping level) varying from 5.4 up to 12.1 wt% [11, 12]. Ultra-violet (UV) radiation induced structural changes in a polymeric material depend on energy of the incident electromagnetic (EM) radiation; UV radiation can cause modification of properties as well as microstructural changes in a polymeric material [16–24]. Non-ionizing radiation, such as UV light will induce chemical transformations (due to radical formation) in the sample. Excitation of polymer molecules can also take place in a material on exposing it to high energy EM radiation; the generated free radicals and ions are reactive, and hence, they are responsible for chemical changes in the material. Radicals created in the UV irradiated polymer sample can interact with one another and recombine to form the parent polymer molecule or alternatively, the radicals can cross-link; that is, combination of radicals to form a new polymer molecule could take place. Depending on the type of polymeric molecules and irradiation conditions, reaction between radicals could ultimately result in polymeric chain scission, leading to degradation of polymeric samples exposed to UV radiation [25].

The details of an experimental study on microstructure and spectroscopic properties of UV irradiated $CdCl_2$ doped PVA–PVP films are presented in this paper. It is to be noted that in-situ production of nano-structures in a polymeric host (through either reduction or decomposition processes of appropriate precursors in a polymeric host) is a desirable feature in the preparation of nano-structured polymeric composites, for various applications. This study is important (from the application point of view) in areas like optics, electronics, UV shielding and electromagnetic (EM) shielding. In a paper by Li et al. [26], the applications of polymer-inorganic nano-composites (PINCs) are reviewed. The disadvantages of using inorganic nano-structured materials could be overcome by incorporating a relatively small amount of nano-particles in the polymeric host. However, these particles should be dispersed in the polymer matrix, so that they

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