chemistry proceedings

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Abstract

Optical characterization of acetone-sensitive thin films of poly(vinyl alcohol)-g-poly(methyl acrylate) †

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† Presented at the CSAC2021: 1st International Electronic Conference on Chemical Sensors and Analytical Chemistry, online, 01–15 July 2021.

Organic solvents are widely used as reaction media and/or for separation and purification of synthetic products in chemical and pharmaceutical industries. Many of those solvents, among them acetone, are considered to be harmful to human health. Detecting vapors of such volatile solvents presented in the air can be achieved by multiple devices and materials [1], but optical detection have few important advantages such as room temperature detection without need of electrical power supply and easy detection when it is based on color/reflectance change. To achieve that, an acetone-sensitive copolymers were designed by grafting poly(methyl acrylate) side chains onto poly(vinyl alcohol) precursor. Copolymer aqueous dispersions were used for thin films deposition on silicon substrates by applying spin-coating method. Optical and sensing properties of the film- refractive index n and extinction coefficient k, as well as thickness d, were determined from measured reflectance spectra R by using two-stage nonlinear curve fitting method [2]. To evaluate sensing properties of the films they were placed in quartz cell and the atmosphere inside was constantly changed from air to argon to acetone using homemade bubbler system (Figure 1).

Citation: Lastname, F.; Lastname, F.; Lastname, F. Title. *Chem. Proc.* **2021**, *3*, x. https://doi.org/10.3390/xxxxx

Published: 01 July 2021

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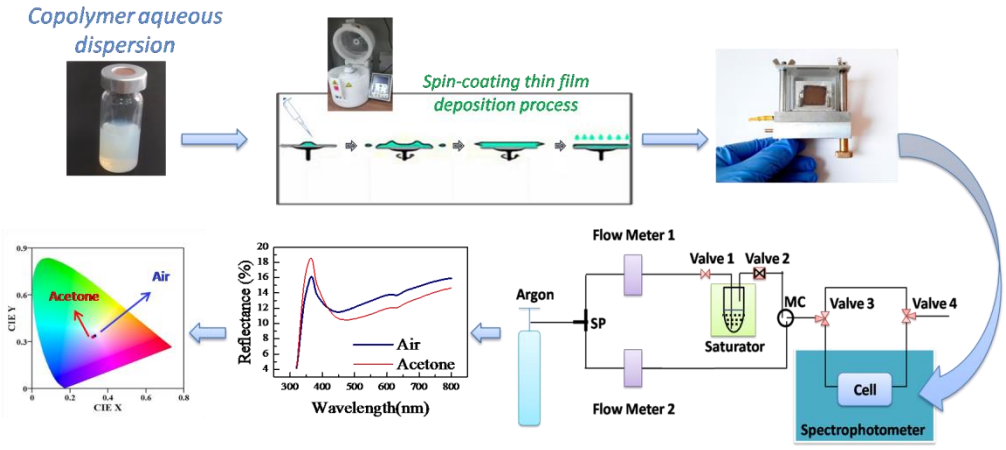

Figure 1. Scheme of the detecting of acetone vapors process.

Reflectance spectra were measured before and during exposure to acetone vapors and were used for calculating optical constants and thickness of the films in the presence of acetone vapors. When exposed to the vapors the copolymer side chains swell due to

absorption of acetone and as a result the film thickness increases while its refractive index decreases. This leads to shift of reflectance spectrum toward longer wavelengths and change of the color of the film (Figure 1). The values of reflectance change along with n, k and d were calculated and the influence of copolymer characteristics on the acetone vapor-responsive properties of the studied films was discussed.

Funding: This research received no external funding

Acknowledgments: S. Bozhilova acknowledges the National Scientific Program for young scientists and postdoctoral fellows, funded by the Bulgarian Ministry of Education and Science (MES) with DCM 577/17.08.2018.

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