

Raman spectroscopy applied to molecular transformation of photochromic polymers

R. Delgado Macuil¹, V. López Gayou¹, M. Rojas López¹, A. Orduña Díaz¹ and R. Ramos García².

¹Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada del IPN, Unidad Puebla. Acatlán 63, Colonia La Paz, Puebla, Pue. México

²Instituto Nacional de Astrofísica Óptica y Electrónica, Sta. Maria Tonantzintla Puebla, Pue. México.

ABSTRACT

Photochromic polymers are materials with high potential for applications in optical devices. In this work we analyzed the polymeric matrix effect in conversion and reversion efficiency of spiropyran through Raman spectroscopy and fluorescence. Argon laser in 514 nm was used as excitation source. The results show the increase of fluorescence over the illumination time, one peak in $\lambda=571$ nm was present. The peak is associated with the molecular reversion from merocyanine to spiropyran.

Keywords: Raman spectroscopy, photochromic materials, spiropyran.

1. INTRODUCTION

The development of photonic technologies is related directly to the question of the availability of optical materials that are adapted for particular applications. For instance, many image processing systems such as holographic correlators and interferometers require materials with reversible photoexcitation mechanisms that would permit the creation of self-developing holograms. The reversible photoexcitation in some materials induced photochromic transformation better known as photochromic effect. The photochromic effect is usually defined as the reversible photo or thermally induced transformation between molecular states whose absorption spectra are different.

One of the most studied photochromic materials were the spiropyrans, which were used to develop: volume transmission holograms [1-3], polymer waveguides [4], optical memories and optical switches [5,6], displays, filters of variable optical density and lenses of variable optical focus length [7]. In general, spiropyran absorbs in the ultra violet (UV) region but not in the visible region. Upon UV illumination, the spiropyran undergoes heterolytic cleavage of the NO bond to form the colored isomer (merocyanine). The coloration change (colorless to blue) in the sample is the physical observation of the molecular transformation. This process can be reversed either by illumination or by heating. The figure 1 show this process, the cis-cisoid isomer is an intermediate process in this molecular transformation and it is associated to degradation of the sample.

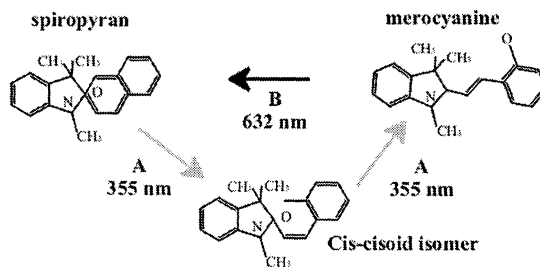


Fig. 1. Schematic molecular structure of the sample before UV illumination (for example at $\lambda = 355\text{nm}$) and after isomerization. The process is reversible when illuminated with visible light (for example at $\lambda = 633\text{nm}$). The cis-cisoid isomer is an intermediate process in the conversion cycle between spiropyran and merocyanine.