Photo-induced reorientation of molecules in dye micro crystals

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Upon massive generation of anisotropic grains of azo dye methyl orange in a gelatin film exposed to active polarized light, a cluster of micro crystals with optical axes of similar orientations has been produced. The anisotropy observed has been found to disappear under exposure to active natural light.

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It is well known that the over saturation of a gelatin film with a dye may occur in two ways — through "massive crystallization" (grain generation) or without crystallization.

The exposure of a gelatin film oversaturated with azo dye chryzophenin to active polarized light will result in grain anisotropy[1,2]. In one case, the anisotropy will occur by the photo induction of dye grains, and, in the other case, by selective photodisintegration of anisotropic grains in a spontaneous massive "crystallization" film.

The present authors seek to investigate anisotropic photo-induction in a gelatin film oversaturated with azo dye methyl orange (heliantine)[3], this was also studied in Refs. [4—6] in connection with Weigert effect.

At first film anisotropy by photo-induced reorientation of molecules in dye micro crystals which generated during massive crystallization is obtained. Unlike Ref. [2], an anisotropy here is generated not by non-facet particles — crystallites, but orientated differently (micro crystals having similar orientation optical axes).

Gelatin solution oversaturated with azo dye methyl orange (its structural formula represented in Fig. 1) was poured on a microscopic slide and subjected to air-drying. The drying resulted in the formation of a thin gelatin layer on the microscope slide.

The film was then placed on flourometer-microscopic stage to be observed with polarizing filters closed. The observation through microscope has shown the film to be full of dye anisotropic crystals-anisotropic grains of nonlinear shapes and containing dye-micro crystals as well. The optical axes of anisotropic grains are quite randomly arranged and have differing interference color, with orange and blue interference color prevailing.

The film was exposed to polarized active light in the limit of 500 nm wavelength, light polarization vector making angle of 45° with the axes of the closed polarizing filters. An active light focusing on the film was made from 100-W mercury bulb during 30 minutes by using of objective 40/0.75.

Upon exposure to light, in the blue interference section of the film a trace was left from the irradiation. Figure 2 offers the picture of the scene observed through the microscope under magnification power of 600. The dye anisotropic grains are clearly visible and the trace left by irradiation in the central section is represented by a group of micro crystals. The peculiarity lies in the fact that rather than being associated with the orientations of the crystals, the orientations of the optical axes of micro crystals in the irradiated section of the film are dependent on the orientation of the polarization vector of the irradiated light. Sure enough, when turning microscopic slide through an angle of 45°, the images of all crystals will disappear regardless of their differing orientations, as shown in Fig. 3, which means that in dye

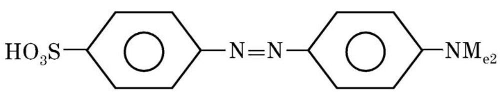

Fig. 1. Structural formula.

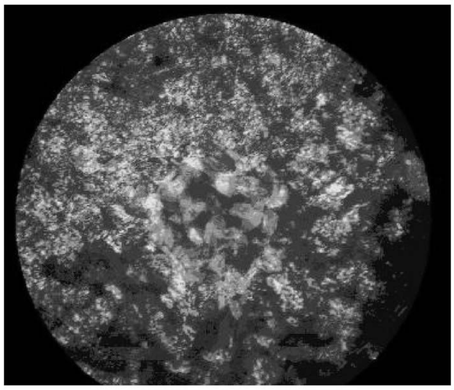

Fig. 2. Crystals of dye in closed polarizators having photo orientated optical axes in clear position.

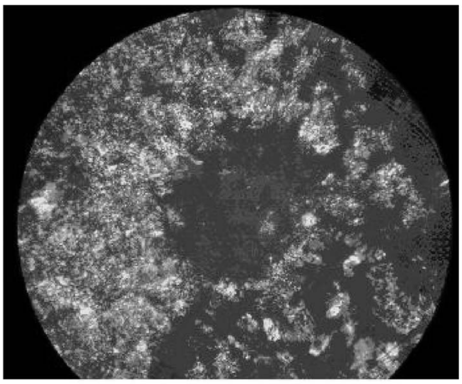

Fig. 3. Crystals of dye in closed polarizators having photo orientated optical axes in darkening position.

molecular crystals photo reorientation of molecules takes place. It may be contacted to cis-trans izomerization that is characterized for heliantine[5].

In addition, we have found that the anisotropy created by the cluster of micro crystals will disappear under exposure to natural active light, with no disintegration of crystals occurring. It should be noted that the reorientation of molecules is generally characteristic of the molecular crystals of organic compounds[7], and also for dye-doped nematic liquid crystals[8].

The micro crystals which are generated by exposure of gelatine film oversaturated with methyl orange dye to active polarized light, will be observed. It has been found that micro crystals with differing orientations have similar orientation optical exis. And when it is exposured with natural active light, the anisotropy of micro crystals will disappear.

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