

A photographic film with reversed microemulsions of silver halide

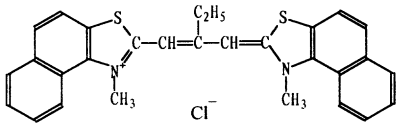
Chun-yan Liu, Zhi-ying Zhang
(Institute of Photographic Chemistry, Chinese Academy of Sciences Beijing, 100101, China)

Abstract

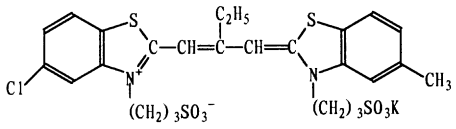
A photographic film with the reversed micro-emulsion of silver halide was prepared. The grain size of silver halide in the range of 3~20nm in reversed micelles can be highly controlled. The material unsensitized is not photosensitivity to room-light, with dye-sensitized, however, the sensitivity of the film increased ca. 128 times. It was supposed that the size and surface effects of small grains, as well the room and electrostatic effects of the water pool for reversed micelles are responsibility for the high spectral sensitization effect.

Experiments

The nanoparticles of silver chloride were prepared as description elsewhere [1]. The structure of dyes used in the present work are below:



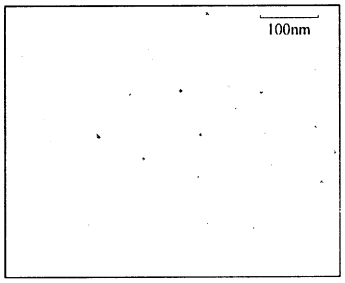
Dye 1



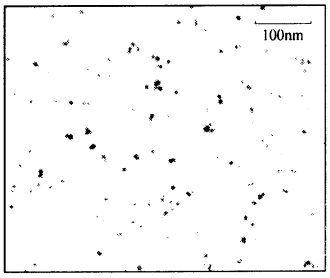
Dye 2

Results and discussion

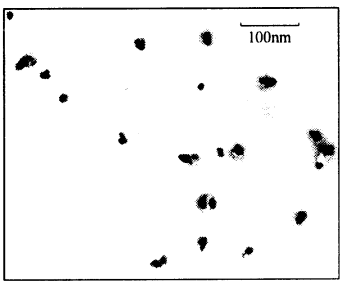
A photographic film of the reversed micro-emulsion of silver chloride was prepared in our laboratory. The grain size of silver halide in the range of 3~20nm can be highly controlled in AOT reversed microemulsions (Fig.1).



1



2



3

Fig 1 TEM images of AgCl grains in AOT reversed micelles. For image 1: AOT=0.1, ω=10, $AgNO_3$=0.25mol/L; the image 2: AOT=0.5, ω=10, $AgNO_3$=0.25mol/L; the image 3: AOT=0.2, ω=70, $AgNO_3$=1.7x10^{-2}mol/L, and Cl^- excess 10% relatively to silver nitrate for every experiment

The material unsensitized is not photosensitivity to room-light, for the film with dye-sensitized, however, the sensitivity increased about 128 times. Fig. 2 is the D-log E curves for unsensitized and photosensitized photographic films with reversed micro-emulsion of silver chloride.

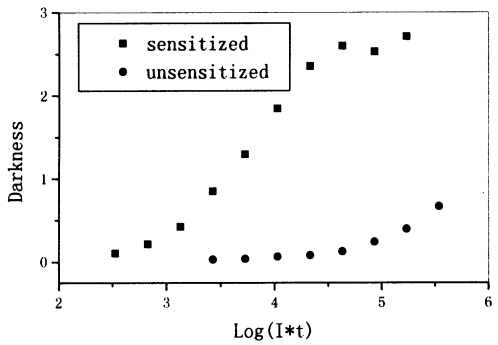
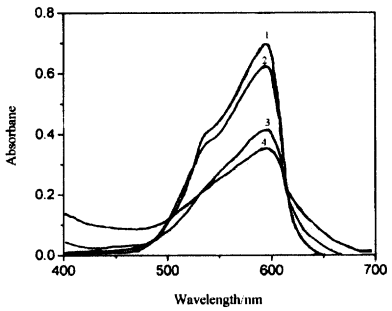


Fig 2 The darkness of sensitized (dye 1) and unsensitized filmwith AgCl grains sized 7 nm in AOT reversed micelles.

As noted by Zhang et al [1], the spectral properties of the dye 1 in AOT reversed micelles are very different from in water or alcohol solution. The dye 1 exhibited no fluorescence emission in pure water or alcohol, while it showed very strong fluorescence emission at 625 nm with a weak shoulder peak at a long wavelength in the AOT reversed micelles. It was supposed that the dye in reversed micelles may have stronger rigidity and weaker radiationless transition, because of the microenvironment effects of reversed micelles. The fluorescence can be quenched by AgCl particles. Fig.3 showed, as increasing the concentration of AgCl particles, the fluorescence was quenched gradually. That means, the electrons for fluorescence emission transfer to AgCl particles.

Fig. 3 The absorption spectra of the dye 1 in AOT



reversedmicelles in the presence of AgCl nanoparticles. The concentration of AgCl for the curves from 1 to 4 is 0, 3.26, 8.69 mol/L, respectively.

These phenomena are not special for the dye 1. Experiments showed here, the spectra of the dye 2 evoluted in the AOT reversed micelles comparing with that in aqueous or alcohol solution. As shown in Fig. 4, the dye 2 showed only 2 absorption peaks in water and alcohol, and no fluorescence emission. In the reversed micelles, however, J-aggregate of the dye 2 appeared and a strong fluorescence was determined.

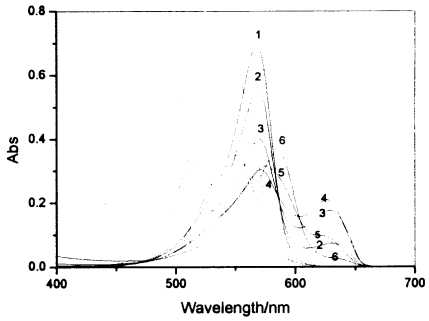


Fig.4 The absorption spectra of the dye 2 in water (the dotted line), in alcohol (broken line) and in the AOT reversed micelles containing AgCl nanoparticles (curves from 1 to 6). The concentration of AgCl for curves from 1 to 6 is from 0 to $2.9x10^{-3}$mol/L.

Clearly, the microenvironment of reversed micelles can influence existing state and reaction properties of dyes, which resulted in a high spectral sensitization effect. These advantages, together with the ability to tailor freely the particle size of silver halide in reversed micelles, suggest a rich use to study reactions of the photographic chemistry in the system of reversed micelles or microemulsions.

Reference

1. Zhi-ying Zhang, Chun-yan Liu, J. Photochem. & Photobiol. A:Chem. 130, 139(2000).