

Thermochromic Behavior of Fluoran-Based Mixtures Containing Liquid-Crystalline 4-n-Alkylbenzoic Acids as Color Developers

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Abstract : Thermochromic materials belong to the family of intelligent materials that change their color in response to temperature changes; this ability is called thermochromism. Thermochromic behavior can be displayed by both isolated compounds and multicomponent mixtures. Fluoran leuco dye-based mixtures are well-known thermochromic systems used, for example, in heat-sensitive FAX paper. Weak acids often serve as color developers for such systems. As the temperature increases, the acids melt, and the mixtures become colored. The objective of this research is to determine the influence of acids showing a liquid crystalline nematic phase on the development of the fluoran dye. For this purpose, fluoran-based mixtures with 4-n-alkylbenzoic acids were prepared. The mixtures are colored at room temperature, but they become colorless upon the melting of the acids. The melting of acids is associated not only with a change in the color of the mixtures but also with a change in their emission color. Phase transitions were investigated by temperature-dependent powder X-ray diffraction and differential scanning calorimetry; nematic phases were visualized by polarized optical microscopy, and color and emission changes were studied by UV-Vis diffuse reflectance and photoluminescence spectroscopies, respectively. When 4-n-alkylbenzoic acids are used as color developers, the fluoran-based mixtures become colorless after the melting of the acids. This is because the melting of acids is accompanied by the transition from the crystalline phase to the nematic phase, in which the molecular arrangement of the acids does not allow the fluoran dye to be developed.

Keywords : color developer, leuco dye, liquid crystal, thermochromism

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