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PHOTOGRAPHIC FILM

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This invention relates to light-sensitive photographic film.

Some light-sensitive photographic materials comprise a light-sensitive gelatin-silver halide emulsion layer on one side of a water-impermeable flexible support (such as film or waterproof paper) and on the other side of the support, a gelatin backing layer or anti-curl layer. Such films are sometimes stored with the emulsion layer in direct contact with the gelatin backing layer or anti-curl layer, for example when stored in rolls.

A problem sometimes arising in the use of such film after storage in this manner is the appearance of dark marks in the exposed and processed film. These marks are due to high silver density and this is believed to be due to the emulsion having acquired extra sensitivity in these areas during storage. When film is rolled it is normal for some areas of the emulsion to be in contact with the backing layer, and for other areas to be separated from the backing layer by a thin layer of air. The areas of extra sensitivity have been found to correspond with the areas of contact.

In one case it was found that the extra sensitivity was due, at least in part, to the diffusion of bromide ions from the emulsion to the gelatin backing layer across the areas in contact. No such diffusion can take place across areas separated by even the thinnest air gap.

Emulsion addenda such as KBr are added to emulsions in predetermined concentrations in order to give the emulsions desired sensitometric characteristics and so if these concentrations of addenda fall in the areas of the emulsion in contact with the backing layer, the emulsion characteristics in these areas will tend to change. Such changes may be only of the order of loge 0.05 speed units but since they occur non-uniformly the effect on the silver image is clearly visible.

According to the present invention the effect of such diffusion of addenda from an emulsion into a layer in contact therewith is counteracted by providing in the contacting layer a supply of diffusible addenda which affect the sensitometric properties of the emulsion in the same way as the diffusible addenda in the emulsion and at a balancing concentration such that the diffusion of the addenda into the emulsion from the backing layer causes the sensitometric properties of the emulsion to remain sufficiently uniform.

According to the present invention the addenda provided in a backing layer or other layer of a photographic film, the emulsion layer of which may come into contact with backing layer on storage, may be the same as the addenda which diffuse from the emulsion to the layer or they may be different diffusible addenda or they may comprise both the same and different addenda.

For example, if bromide ions diffuse from the emulsion into the backing layer a diffusible bromide salt may be provided in the backing layer at approximately the same concentration as in the emulsion. Alternatively, if the backing layer has any inherently desensitizing action on the emulsion, as some gelatins have, then this action will, in part, cause the areas of the emulsion in contact with it to lose sensitivity and partly balance the increase in sensitivity due to the loss of bromide ions. In this alternative, rather less of the diffusible bromide will be required in the backing layer than when the layer has no desensitizing

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ing action. Thus, in one case it was found that a concentration of soluble bromide ions in a gelatin layer 0.4 times their concentration (in grams per unit weight of gelatin) in the emulsion layer was sufficient to balance the effects of the loss of bromide from the emulsion in the areas of contact. Since the addenda which are incorporated in the backing layer according to this invention have a sensitometric effect on the emulsion, care must be taken not to incorporate more than is necessary for balancing sensitometric properties. We believe that for bromide ion this balancing concentration will be found to lie within the limits of 0.25 to 4 times that of the bromide in the emulsion. Any readily ionizing soluble bromide may be used, so long as the cation with which it is associated has no marked sensitometric action.

In another alternative a diffusible compound is added to the layer which is not a bromide but is a compound, e.g. an organic compound, which has a desensitizing action on the emulsion, e.g. a tetrazaindene. The diffusion of this compound into the emulsion causes a fall in sensitivity where the loss of bromide ions causes an increase. The concentration of the compound in the layer in this alternative will depend in part on the intensity of its effect on the emulsion as compared with that of the addendum diffusing into the layer.

As a modification of this alternative the pH of the gelatin backing layer may be adjusted to balance the effect of migration of addenda from the emulsion.

The concentration of the addendum in the backing layer of a photographic film according to this invention is such that sufficient of the addendum diffuses into the emulsion layer to balance the effect on the sensitometric properties of the diffusion of the same or other addenda from the emulsion to the backing layer. The concentration is determined in relation to at least three factors:

(1) the concentration of the addendum in the emulsion (expressed in grams of addendum per gram of gelatin).

(2) the nature and purity of the colloid of the backing layer, in particular whether it has any inherent influences on the sensitive layer.

(3) any other addenda added to the colloid, e.g. hardeners, which have an influence on the sensitometric properties of the emulsion.

By "diffusible" is meant herein diffusible from a photographic emulsion layer to a colloid layer or from a colloid layer to an emulsion layer, the emulsion layer and colloid layer being in contact. For the purposes of this invention diffusion of various compounds in gelatin can be tested at relative humidities of about 60%. Some addenda may be diffusible in plain gelatin but not in a gelatin silver halide emulsion owing to chemical or physical association of the addenda with the silver halide.

Whether or not a particular addendum in an emulsion or colloid layer is diffusible therefrom may be tested in the following way:

A layer of plain gelatin on film is maintained in contact with a layer of the emulsion (or with a layer of the colloid) containing an appropriate concentration of the addendum on another piece of film at a relative humidity of about 60% at a temperature of 60°–70° F. for up to 6 months. Then if any addendum in the emulsion or colloid layer is diffusible, it will be detectable analytically in the gelatin layer. The area of contact can be increased and the total rate of diffusion into the gelatin layer thereby increased by pressing the two films together. If the backing or other layer of the film to be manufactured is not plain gelatin but some other water permeable material, then this test is preferably carried out with a layer of that material in contact with the emulsion.

It will be noted that this invention is concerned with balancing the effect of loss of compounds from emulsions

which have been added thereto to control the sensitometric properties of the emulsion, and therefore only compounds with such properties are envisaged for addition to the backing layers. Other compounds are added to emulsions for other reasons, e.g., alkali metal chlorides and nitrates and for plasticizing or as humectants or as hardeners. Whether or not such compounds migrate from the emulsion by diffusion they are not added to a backing or other layer in performing this invention.

In performing this invention there will be produced a photographic film having on one side of the support a light sensitive silver halide emulsion layer containing a diffusible addendum affecting the sensitometric characteristics of the light sensitive silver halide and on the other side of the support a colloid backing layer or layers one or more of which contains a diffusible addendum which has an effect on the light sensitive silver halide sensitometrically similar to that of the addendum present in said emulsion layer.

The colloid in both layers may be gelatin or it may be a freely water-swellaible colloid or a colloid removable by suitable aqueous solutions, such as cellulose acetate phthalate.

In one embodiment of the present invention there is produced a photographic film having a light sensitive gelatino-silver halide emulsion layer, the silver halide of which comprises silver iodo-bromide, on one side of the support and on the other side of the support a gelatin backing layer containing a diffusible bromide such as KBr, at a balancing concentration which may be from $\frac{1}{4}$ to 4 times, e.g., 0.4 times the concentration at which it is present in the emulsion.

Photographic light-sensitive films provided by the present invention can be stored in roll form with substantially reduced danger of the appearance of defects in the exposed and processed film due to loss of emulsion addenda to the colloid backing layer.

The present invention is illustrated by the following examples. Parts are by weight.

Examples

Four samples A, B, C, and D of a photographic film having a fine grain high-contrast gelatin silver iodobromide emulsion were prepared in the normal way each containing potassium bromide in the emulsion layer at a concentration of 1 part per 100 parts of gelatin in the layer.

Sample A had a gelatin backing layer containing no KBr.

Sample B had a gelatin backing layer containing 0.5 part of KBr per 100 parts of gelatin.

Sample C had a gelatin backing layer containing 1 part of KBr per 100 parts of gelatin.

Sample D had a gelatin backing layer containing 2 parts of KBr per 100 parts of gelatin.

Each of the above samples was incubated with the emulsion layer in contact with the backing layer. After incubation each sample was uniformly exposed and developed.

Sample	Density difference between the area of contact and out-of-contact background
A-----	+0.09 (sensitization).
B-----	-0.02 (very slight desensitization).
C-----	-0.2 (desensitization).
D-----	-0.39 (desensitization).

The above results particularly in the case of sample B show that the presence of KBr in the gelatin backing layer reduced the level of extra sensitization of the emulsion layer which otherwise occurred on contact with the gelatin layer.

I claim:

1. A photographic film comprising a film support containing on one side only a bromide ion containing gelatin-silver halide photographic emulsion layer, of the halide of which bromide comprises a substantial proportion, and on the other side a gelatin backing layer, said backing layer containing bromide ion of a salt having a photographically innocuous cation in an amount 0.25 to 4 times the amount of bromide ion in the photographic emulsion layer.

2. A photographic film comprising a film support containing on one side only a bromide ion containing silver halide emulsion layer, of the halide of which bromide comprises a substantial proportion, and on the other side a backing layer containing bromide ion, in the form of potassium bromide, in an amount of 0.25 to 4 times the bromide ion in the photographic emulsion.

3. A photographic film comprising a film support having on one side a bromide ion containing silver halide photographic emulsion layer, of the halide of which bromide comprises a substantial proportion, and on the other side a backing layer, said backing layer containing bromide ion of a salt having a photographically innocuous cation in an amount 0.25 to 4 times the amount of bromide ion in the photographic emulsion.

4. A roll of photographic film comprising a roll of a support having a bromide ion containing silver halide photographic layer on one side only, of the halide of which bromide comprises a substantial proportion, and a backing layer on the opposite side in proximate contact with the emulsion layer of the film roll, said backing layer containing bromide ion of a salt having a photographically innocuous cation in an amount 0.25 to 4 times the amount of bromide ion in the photographic emulsion layer.

5. A roll of photographic film composed of a support having a bromide ion containing silver halide emulsion layer on one side only, of the halide of which bromide comprises a substantial proportion and a backing layer on the other side in proximate contact with the emulsion layer, said backing layer containing potassium bromide, the bromide ion of which is 0.25 to 4 times the amount of bromide ion in the emulsion layer.

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