SPECIAL PHOTOGRAPHIC EMULSION WITH CONTROLLED SENSITIVITY

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SPECIAL PHOTOGRAPHIC EMULSION WITH CONTROLLED SENSITIVITY

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Results are reported that were achieved in developing a special type of emulsion whose sensitivity can be controlled during its exposure by means of a pulsed electric field. Since the controlled emulsion is subsequently intended for use in recording tracks of charged particles, the synthesis was based on the formulation and technique ordinarily used in preparing photographic emulsions for nuclear investigations.

The diameter of the silver halide microcrystals of the controlled emulsion is 0.15–0.30 μ, and the concentration of silver halide salts is of the order of 55–60 wt. %. The principal difference between this emulsion and highly sensitive nuclear emulsions consists in the fact that the sensitivity centers (electron traps) are created during synthesis not only on the surface of the microcrystals but also, in large numbers, inside the microcrystals. The sensitivity of such an emulsion to light is very low in the absence of a field and increases sharply when a field is applied.

The influence of a pulsed electric field on the recording ability of certain standard light-sensitive photoemulsions was investigated in works ([1]–[3]). It was established that the sensitivity of "Kodalit" photoemulsion, under the simultaneous action of an electric field with intensity up to $4 \cdot 10^6$ V/cm and duration from 12 to 100 μsec and of a light flash of duration 100 μsec, increases by a factor of 2–2.5 ([1]). In works ([2], [3]) a certain increase in sensitivity was also observed for "Fudzilit" film (an analogue of "Kodalit") and for the domestic FT-SK film under approximately the same conditions, but with a shorter light flash (~ 1 μsec).

In our work, layers of the experimental emulsion without a support, 30 to 80 μ thick, were placed between two flat electrodes made of optical glass, the surface of which was coated with a transparent layer of $SnCl_2$. The layers were subjected to a single exposure of duration 1–3 μsec from an IFK-20 lamp through a step gray wedge.

The triggering system ensured simultaneous switching on of the lamp and application to the electrodes of a rectangular high-voltage pulse with variable

duration and amplitude (Fig. 1) from a specially constructed generator. The electric-field strength in the controlled emulsion could reach 10^6 V/cm without the occurrence of electrical breakdown.

Figure 2 gives the characteristic curves (1 and 2) corresponding to the negative image of the wedge obtained with a single light flash on one of the samples of the experimental emulsion. The region corresponding to the upper zone of wedge fields was under the action of a synchronously applied electric field with $E = 7 \cdot 10^5$ V/cm for 20 μsec, while in the region under the lower zone the electric field was absent during this time. For clarity, a photographic print of this sample is shown in Fig. 3.

Fig. 3. Photograph of the image of a wedge obtained on a sample of the experimental emulsion: **a**—region subjected to the action of an electric field $E = 7 \cdot 10^5$ V/cm; **b**—region not subjected to the action of the field.

Figure 2 also shows curve 3, obtained under the same conditions with a fivefold repeated light pulse without application of an electric field. It follows from the curves that, with a single application of a field of $E = 7 \cdot 10^5$ V/cm, the sensitivity of the emulsion can be increased by approximately a factor of 10.

Fig. 1. Shape and temporal relationships between the trigger, light, and voltage pulses.

Fig. 2. Family of characteristic curves of the experimental emulsion.
1 –1 light pulse, $E = 7 \cdot 10^5$ V/cm;
2 –1 light pulse, $E = 0$;
3 –5 light pulses, $E = 0$.

By changing the field strength, one can regulate the degree of increase in the sensitivity of the emulsion we have developed.

Under identical exposure conditions, in an emulsion that is insensitive in the absence of a field (the maximum blackening density does not exceed 0.2 above fog), with a single application of the field one can obtain a density range from 0.15 (fog density) to 3, with a latitude of not less than 50 (in units of H).

The creation of a photoemulsion with controllable sensitivity greatly expands the possibilities for the use of photography.

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Note: Figure translations are in progress. See original paper for figures.