

# Applications of Color Photography of Infrared Ray in Testing of Material Evidence

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## Abstract

Color photography of infrared ray was applied in the testing of material evidences in the research. We found the images of this technique can demonstrate clearly some important, fine details in original testing material evidence which are imperceptible by eyes. The simple, rapid and accurate attributes make this technique more applicable in the testing of material evidences.

## Descriptive Summary

Color photography of infrared ray is a technology method which material reflect intensity of green light, red light and infrared ray to form color picture in color film of infrared ray. Infrared ray is imperceptible light, with strong penetrating ability, small medium refraction rate. When infrared ray penetrates body surface, to form color infrared image through body reflecting is recorded in the color film of infrared ray. Details in material not visible by eyes can be expressed and seen through color photography of infrared ray, so achieved the testing purpose.

Color photography of infrared ray has a common character with color photography: the sensitive materials are made from three layers of sensitive coconut milk, and they could form images from three kinds of color light. But these two techniques have two differences:

A. Color photography of infrared ray records green light, red light and infrared ray to form image, while color photography records blue light, green light and red light to form image.

B. Color photography of infrared ray is a kind of false color. It only records intensity of green light, red light and infrared ray reflected from material and form the blue, green, red color picture on color film of infrared ray. Photography of color infrared ray does not really reflect color of objective world, for example, red flag is green in the photography, but color photography really reflect color of objective world.

Color of body and picture has following relation by photography of color infrared ray:

| Color of body  |   | Color of photograph |
|----------------|---|---------------------|
| white          | ↔ | white               |
| blue and black | ↔ | black               |
| green          | ↔ | blue                |
| red            | ↔ | green               |
| infrared       | ↔ | red                 |

Although color photography of infrared ray does not show the reality of object, its color expression and balance have important significance to the testing of material evidence.

## Technical Methods

### Basic Devices

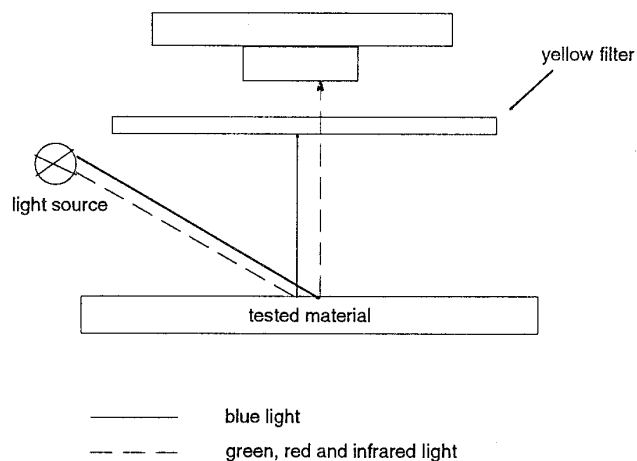


Figure 1.

### (1) needed equipments:

- a. camera;
- b. yellow filter;
- c. light source;
- d. color film of infrared ray.

### (2) notes:

- a. There are property of dispelling image difference and color difference on the camera lens;
- b. infrared ray can't penetrate the camera;
- c. light sources are general tungsten filament light.

### Illumination Technology

Tolerant degree of color film of infrared ray is small, coefficient of contrast is large. Allocated light need to form a small difference of brightness. It pledges bright part and dark part of body to obtain accurate exposure. Allocated light rate of color photography of infrared ray is less than that of ordinary photography.

### Filter Technology

In different infrared wave band, body has different abilities of reflex and absorption. Therefore in different infrared wave band, body obtains different brightness in color photography of infrared ray. We can obtain useful details to receive the information in correct infrared wave band. Color film of infrared ray is very sensitive for blue light, but blue light can destroy color balance of image. Therefore, blue light must be prevented into the camera by using yellow filter on the camera lens.

### Focalizing Technology

According to the formula:  $n = A + B/\lambda$  ( $A$ ,  $B$  are positive constant),  $n$  with  $\lambda$  is inverse ratio. Infrared wave length is longer than that of sight of light. Therefore  $n_{ir} < n_{si}$ , infrared focus is larger than that of sight of light on lens. If we photograph after focalizing by sight of light, infrared image falls behind the plane film. The image may be indistinct (as shown by Figure 2).

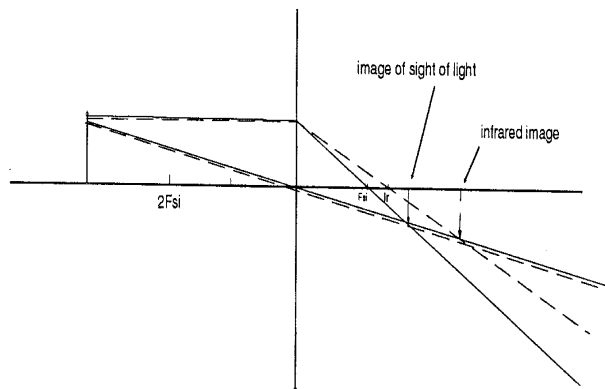


Figure 2.

The image of green light, red light and infrared ray to form can be photographed by color photography of infrared ray. The best focalizing method is: in order to extend clear range the camera aperture is reduced after using red light focalizing.

### Exposure Technology

Because tolerant degree color film of infrared ray is small, we must control exposure accurately in color photography of infrared ray. In majority condition, exposure error is only permitted  $\pm 1/2$  level. Exposure of color photography of infrared ray depend on mainly the sensitive speed of the film, the ability of body reflecting infrared ray and the intensity of infrared ray. The sensitive speed of infrared film is relative sensitive speed in the condition of light source and filter to be fixed. When the other light sources and filters are used, the sensitive speed of the film can only regard as reference. Measuring the intensity of infrared ray and measuring the intensity of

body reflecting infrared ray are difficult. The intensity of body reflecting infrared ray can't be measured by ordinary light meter, therefore, to define exposure is difficult by measured method too. The exposure of color photography of infrared ray maybe defined by a series of exposure experiment. To define reference exposure by a series of photographing can find correct exposure in condition of light source and filter to be fixed.

### Applicable Cases in Testing of Material Evidence

If the body is hurt by blunt, but the skin face appears well, whether there is extravasated blood in the body or not, and how much there is the extravasated blood area in the body, could be tested by color photography of infrared ray.

### Interpretation of Images of Color Photography of Infrared Ray

1. To get hurt place photographed by photography of color infrared ray. If the skin face has red and green spot in the photograph, it explains that the red and green spot is extravasated blood. Because infrared ray has a strong penetrating ability to arrive the extravasated blood position in the skin, the blood in that position reflect infrared ray to form red and green image in the photograph.
2. In the photograph of color photography infrared ray, red image is formed by the material evidence reflecting infrared ray. Infrared ray is imperceptible by eyes but color photography of infrared ray is sensible through red image, so widened one's outlook.
3. Color photography of infrared ray can test bullet and metal substance in the body and it shows blood vessel distribution.

### Notes

1. Blue light must be prevented into the camera in color photography of infrared ray by using yellow filter on the camera lens.
2. 760 - 900 nm infrared ray should have enough intensity in the light sources.
3. The color of photograph is very critical for testing of material evidence, so do not produce color deviation.

### Conclusion

It is very accurate, rapid, simple and convenient to use color photography of infrared ray. The color photography of infrared ray is an important application technology in testing of material evidence.