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NOTE

Photochemical Properties of Copper(I) Halides Film by Obtaining on the Surface of Copper and its Alloys

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In this work is given the results of photochemical properties of covering of copper(I) halides, receiving on a surface of copper and its alloys.

Key Words: Photochemical properties, Photosensitive film, Copper(I) halides, Solar beam.

In this work the photochemical properties of the films formed on a surface of copper and its alloys at special processing were investigated. As samples at production of films flat metal plates with a smooth surface were used mainly. Majority of experiments have been spent on the plates from copper and brass. Separate experiences have been put on samples from nickel, glass and polymeric materials on which surface the galvanic or chemical way had been put a copper film and also a film of copper phosphorous alloy[1].

Preliminary preparation of samples (grinding, degreasing, etching) was performed by the standard methods in galvanotechnics[2].

For production of a photosensitive film samples processed a solution of copper(II) chloride or bromide. Thus these compounds interact with a copper blanket on following reactions:

$$CuCl_2 + Cu \rightarrow 2CuCl$$

$$CuBr_2 + Cu \rightarrow 2CuBr$$

These compounds form whitish films on a surface of the sample.

If on the sample right after such processing influence solar beams, its surface is darkened. The dimness of the sample occur instantly at the moment of its drying. Besides, it has been found, that if separate sites of a surface of sample to shield from solar beams, these sites do not darken. It has also been established, that, if the sample preliminary to dry up in a dark place and then to expose on the sun, dimness of the sample does not occur. Hence, photochemical reaction proceeds only at the moment of drying of a damp film. The damp film represents supersaturated solution of copper(I) halides, that is a liquid phase and at drying the firm phase it is possible to present this reaction as transitive-phase interaction of quantum of light with chloride or bromide of monovalent copper is formed. This feature of photochemical reaction, probably, also caused that a photosensitivity of monovalent copper has not been described till now in scientifically- technical literature.

In the following experiments more dark (close to black) films are formed at processing of samples in the solutions containing copper(II) sulphate and potassium bromide.

Results of research on influence of components of this solution on a photosensitivity of films are resulted in Table-1. Thus were visually defined colours of a film after an irradiation by solar beams, contrast between opened and enclosed to sites of a surface of the sample. From Table-1 it is visible that the amount of $CuSO_4 \cdot 5H_2O$ 30 g/L, KBr 10 g/L is optimum.

Fig. 1 showed the change of colour of a film on the copper sample in separate stages of process. Similar results are received on samples from a brass, bronze, monel-metal and also on copper coverings, copper-phosphorous alloy put on various bases.

It has also been revealed, to receive black - white pictures by contact way. It is also found, that at long storage in a dark place the image disappears, but at sufficient illumination again appears.

For the purpose of definition of the mechanism and photochemical reaction products has been made X-ray phase analysis of blankets before and after an irradiation by solar beams.

TABLE-1
INFLUENCE OF STRUCTURE OF SOLUTION ON QUALITY OF COVERINGS RECEIVED BY LIGHT PROCESSING

No.	Content of solution components (g/L)		Get dark degree and contrast after light treatment
	$CuSO_4 \cdot 7H_2O$	KBr	
1	30	30	Grey colour with low contrast
2	30	20	Dark-grey colour, contrastive
3	30	10	Black colour with high contrast
4	10	30	Dark colour with low contrast
5	20	30	Grey colour with low contrast
6	15	5	Grey colour with low contrast
7	20	7	Dark-grey colour, contrastive
8	45	15	Dark colour with middle contrast
9	60	20	Grey colour with low contrast

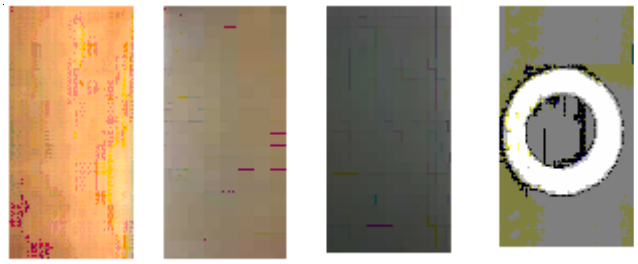

Fig. 1. Change of colour of a film on samples during operation on reception of a photosensitive layer. (1) surface of the initial copper sample; (2) surface of the sample after processing in solution $CuSO_4 \cdot 5H_2O$ 30 g/L, KBr 30 g/L, KBr 10 g/L; (3) surface of the sample after an irradiation solar beams; (4) surface of the sample after an irradiation solar beams at shielding of separate sites.

However, on the received roentgenograms the differences was not observed. In both cases of the roentgenogram corresponded CuBr.

Besides, change of potential of samples after proceeding of photochemical reaction (Table-2) was studied. Measurements were spent in solutions of salts, acids and alkalines. In these experiences in specified electrolytes are lowered two samples from copper, which were processed in a solution of mixture of $CuSO_4 \cdot 5H_2O$ 30 g/L, KBr 10 g/L. Then one of the samples at once was immersed in electrolyte and second after light processing. Then the pressure between these electrodes and also force of a current, proceeding through this circuit was defined. In all experiments in due course pressure between electrodes and force of proceeding current quickly decreased. Within 5-7 min the potentials of samples were leveled. The colour of the sample, processed by light, thus changed from black (2 sample of Fig. 1) up to light as at the raw sample (3 sample of Fig. 1).

TABLE-2
INFLUENCE OF LIGHT PROCESSING ON A CURRENT STRENGTH OF SHORT CIRCUIT AND A POTENTIAL DIFFERENCE

	Solutions							
	NaCI		KCI		H_2SO_4		NaOH	
Electrode charge	« + »	«–»	«+»	«–»	«+»	«–»	«+»	«–»
Kind of processing	1	2	1	2	1	2	1	2
Voltage (mW)	40		34		10		0.2	
current intensity (mA)	2.5		2.5		2.5		0	

*1: Sample processed in solution $CuSO_4 \cdot 5H_2O$ 30 g/L, KBr 10 g/L, *2: Sample processed in solution $CuSO_4 \cdot 5H_2O$ 30 g/L, KBr 10 g/L and passed light processing.

In all these solutions, the potential of sample to the undergone light processing is visible from the Table-2 was more positive, than potential of a sample not past this processing. Maximal shift was observed in neutral solution and minimal in a solution of alkali.

Results of this experiment show, that at processing by solar light on a surface of a sample, the oxidizing process with formation slightly soluble compounds of copper(II) and having more positive potential, compounds of one valence copper proceeds. Probably, it occurs reduction of atmospheric oxygen.

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