THE ROENTGENOGRAPHIC STUDY OF ZINC AND CADMIUM FILMS DEPOSITED IN THE PRESENCE OF COLLOIDS.

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As is well known, colloids are introduced into the electrolytic bath for the purpose of obtaining bright, finely-grained depositions. We studied by X-rays Zn films deposited in the presence of dextrine, and Cd films deposited in the presence of dextrine, sulphonated castor oil and cereal extracts. The conditions of deposition are given in Table I.

It follows from the work of Glocker and Kaupp,[1] and other workers, that during the electrolytic deposition of Cu, Ag, Cr, Ni and Fe in baths of corresponding compositions (in the absence of colloids) there are formed textures, the degree of perfection and axis of which depend on the conditions of the deposition (current density, electrolyte composition, etc.). Bozorth's researches [2] have shown that no texture is observed for

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[1] Glocker a. Kaupp, *Z. Physik*, 1924, **24**, 121.

[2] Bozorth, *Physical Rev.*, 1925, **26**, 390.

Zn and Cd. It is seen, however, from the X-ray diagrams (Figs. 1-2) that, during the electrolytic deposition of these metals (Zn and Cd) in the presence of above-mentioned colloids, a texture can be observed, although an imperfect one, particularly for Zn. (See diagrams facing p. 869.)

For Zn, the (221) planes tend to lie parallel to the surface. We discovered also that the degree of the orientation of crystals depends on the concentration of colloids in the electrolyte (Figs. 3, 4, 6), as well as on the current density (Figs. 4, 5). We propose to make use of this fact as a method for determining the "effective concentration" of a colloid in the bath. The relative intensity of the Debye-gram lines for Zn and Cd films undergoes a sharp change depending on the concentration of the freshly-prepared colloid (Figs. 3, 4, 6, 8, 9, and 10).

TABLE I.

Composition of Electrolyte.	Current Density.	Time of Exposure.	Cathode.
1. Deposition of Zinc.			
$ZnSO_4$ . . . . . 240 gm. $AlCl_3$ . . . . . 15 ,, $Al_2(SO_4)_3$ . . . . 30 ,, H_2SO_4 . . . . . 0·5 ,, H_2O . . . . . 1 litre Dextrine : 0, ¼, ½, 1, 2, 4, 6, 8 and 10 gm.	2 and 5 amp./dcm.^{2}	10, 20 and 40 minutes	Fe
2. Deposition of Cadmium.			
CdO . . . . . 16 gm. KCN . . . . . 200 ,, H_2O . . . . . 1 litre The colloids : Cereals extracts : 0·25, 0·5, 1 gm. Sulf. castor oil : 0·1, 0·2, 0·5, 1 ,, Dextrine : . . 0·5, 1 ,,	0·75, 1 amp./dcm.^{2}	10, 30 minutes	Cu and Fe

As has already been observed during the operation of a bath, there occurs in the course of time a gradual "disappearance" of the colloid. For this reason it seems to be advisable under factory conditions to verify the "effective concentration" of a colloid. The author has obtained a series of X-ray diagrams for Zn and Cd deposited from various concentrations of freshly-prepared colloids (but under the same other conditions of current density, time of electrodeposition, composition of electrolyte, material and treatment of the cathode, etc.), which serve as standards for every control determination of the "effective concentration" of the colloid in the given electrolyte. Thus, the analysis can be accomplished within from 3 to 5 hours.

The Debye-grams were taken with a plane sample, at an angle of 47° to the original beam (a different angle may be used so long as the same angle is always maintained for the determinations) of the Fe or Cr radiation (the anti-cathode may also vary).

We also noticed an increase in the brightness of films, with the degree of orientation of crystallites. This very phenomenon has recently been observed by Wood [3] for Cr and Ni electrodeposited in corresponding baths (not containing colloids).

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[3] Wood, *Trans. Faraday Soc.*, 1935, **31**, 1248.

Thus we can now take it for certain that, in the case of Cd and Zn, colloids bring about the formation of a texture, *i.e.*, they promote the growth of crystals in a single crystallographic direction, *viz.*, perpendicular to the surface of the cathode (see also [4]).

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[4] Froelich, Clark, Aborn, *Trans. Electrochem. Soc.*, 1926, **49**, 369.