account the dimensional changes which occur during twin formation.

It is significant that the hardness anisotropy in the basal planes of zinc and magnesium is similar[5] although the number of twins and their distribution differ in these metals. This suggests that the anisotropy is due to slip rather than twinning. in agreement with the previous results[5]. The effect of indentations on twins already present has also been examined and supports the observations recorded here[6].

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Grain Growth in Cadmium

Much has been written of the growth of the component crystalline grains which occurs when a metal is maintained at a constant high temperature, but hitherto no simple law of growth appears to have been established. Working with cadmium, we have found laws which hold with precision for that metal. Whether they hold for other metals, in particular for metals of face-centred cubic structure, is a matter which we propose to investigate.

In a specimen of which the average grain size is below a certain limit, maintained for a long period at a given temperature, the grains grow to a stable size characteristic of that temperature. If n is the average number of grains intersected by a unit length, taken at random, and n_i, the initial value, is about 1·6, or less, times the stable value n_T ultimately attained, then the law of decrease of n, which is the reciprocal of the average diameter, is:

$$n = n_T (1 + pe^{-qt})$$

or:

$$\frac{n - n_T}{n_T} = \frac{\text{number of mortal grains}}{\text{final number of grains}} = pe^{-qt}$$

when p and q are constants. We use the term "number of mortal grains" to indicate the number that vanish in the course of annealing at a given temperature.

This law is obeyed within the limit of experimental error, which is well less than 1 per cent of the value of n. It has been established that no change in the value of n_T occurs in weeks.

If the initial grain size is much smaller than that given by $n_i = 1{\cdot}6\ n_T$, then there are two preliminary stages of growth, first, a very rapid increase of grain diameter, which at high temperature may lead to a ten-fold increase of the average grain diameter in a matter of seconds, and a second stage in which the exponential law is gradually approached. We have an explanation to offer for this behaviour.

The variation of q with temperature is given by the simple law $q = ae^{-\varepsilon/kT}$, where a and ε are constants. The variation of the stable n_T with temperature is given by $n_T = \frac{A}{(T - T_0)^2}$, where A and T_0 are constants.

It is hoped to publish shortly an account of the experiments in question, with an attempted explanation of the results.

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RADIATION CHEMISTRY

Changes in Titanium Dioxide–Silver Nitrate Mixtures after Ultra-violet Irradiation

The photo-darkening of titanium dioxide–silver compound mixtures has been observed by Förland[1] and Goetz and Inn[2] among others. Förland attributed the discoloration to the oxidation of the silver ion to AgO, though Goetz and Inn claimed that it was due to the reduction of the silver ion to metallic silver.

During investigations into this reaction, interesting reflectance changes were observed on specimens after they had been exposed to ultra-violet radiation. The specimens were prepared by mixing 10 gm of a commercial rutile titanium dioxide pigment with 10 ml. of N/10 aqueous solution of silver nitrate. The paste was dried at 80° C for two days in the dark, and formed into compacts to facilitate reflectance measurements. These were evacuated for 1 h at 10^{-2} torr, and then irradiated for two days in a dry nitrogen atmosphere.

The discoloration has a characteristic pink tinge and the reflectance spectrum of a freshly irradiated sample is shown in Fig. 1, curve *A*. The changes after irradiation depend strongly on the presence of moisture, and follow two patterns. If the specimen is kept in a desiccator in the dark, the discoloration slowly dies away, and the reaction appears to be completely reversible. Fig. 2 shows the increase of reflectance at about 5500 Å with time at 20° C. If, on the other hand, the specimen is exposed to moisture, it slowly blackens in the dark. A typical case of a specimen kept in a normal room atmosphere at 20° C is shown in Fig. 1, where curves *B* and *C* show the decreasing reflectance with time. This darkening continues until the specimen appears dark-grey with an overall reflectance of approximately 10 per cent.

This darkening process follows a particular pattern; small black spots form on the surface of the compact, and then grow, bringing about a darkening effect. The formation of these spots depends on the presence of moisture and is irreversible at room temperature. Detailed

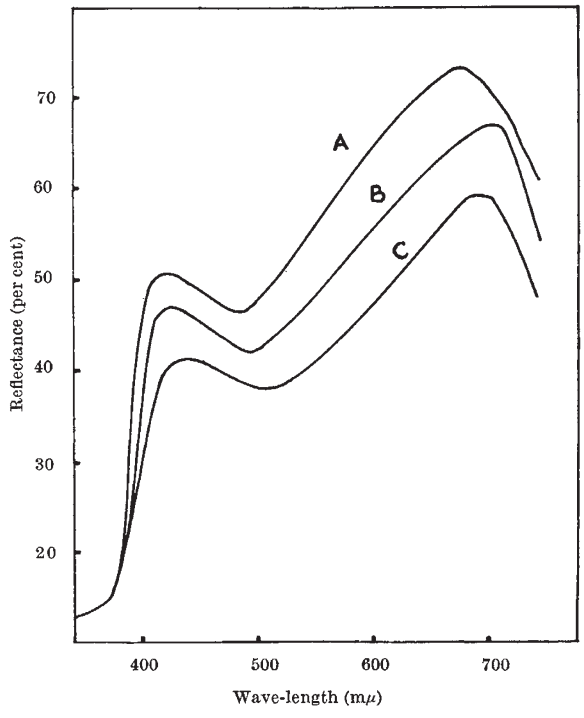

Fig. 1. Reflectance changes measured in a moist atmosphere. *A*, freshly irradiated; *B*, after two days in the dark; *C*, after seven days in the dark