

matter what the deposition velocity of the molecules constituting the outer layers may be. Conditions (a) and (b) can be avoided by properly placed shields and by fast pumping; conditions (c) and (d) are improved by the use of a radiant heater source in preference to a boat.

Closely associated with the foregoing phenomena is the trouble experienced when coating optics on two surfaces. We had noticed that it was difficult to secure a really hard coating on the second side of two-surface optics. The effect was investigated by covering one half of the rear surface of a flat specimen with a cover glass. The front surface was then coated in a normal manner, after which the specimen was turned over and coated on the second side without the cover. Interference colour showed the presence of a thicker layer on that portion of the second surface left unprotected. Moreover, when the eraser test was applied across the line dividing the two halves, hairlining started abruptly at the exposed portion, thus indicating a softer coat. To make sure that the extra deposit was not caused by the heaters (behind the holding fixture), the same experiment was performed with the half-covered side facing the source. The latter was baffled with a cover plate and run for the normal length of time. Next the cover-glass was removed from the specimen and a coating applied in the usual way. The results were identical with the first experiment. Even low-temperature degassing of the source with baffles in position was found to deposit a noticeable undercoat. We surmise that the undercoating observed in the foregoing experiments was a deposit of 'slow fluoride' which reaches the glass by successive collisions rather than direct evaporation from the source. The installation of faster pumps, namely, Distillation Products, Inc.—MC 500, and the development of a special pellet source, which requires no degassing, has practically eliminated trouble due to secondary coating.

It is imperative to avoid the formation of magnesium oxide by excessive muffling or similar treatment in the preparation of pure magnesium fluoride; otherwise a magnesium oxide 'skin', which has a higher melting point than the magnesium fluoride, will form during evaporation and completely cover the surface of the material. It is this layer which causes 'spatter' and consequent pitting of the optics to be filmed.

It might be of interest to mention that with the pellet source and faster pumps, a complete coating cycle from load to unload has been reduced to twenty minutes.

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¹ Bannon J., *Nature*, **157**, 446 (1946).

Molecular Rotation in Keratin

It has been shown by Fricke and others^{1,2} that the dielectric constant of gelatin-water systems may rise to abnormally large values as the water content is increased to about 50 per cent, with a consequent increase in the dielectric dispersion. They suggest that these phenomena may be either due to rotation of dipole ion groups present in gelatin which have been loosened by the sorbed water, or alternatively to the outer layers of less firmly bound water, in excess of the monolayer, which by concerted rotation exhibit 'ferro-electric' properties.

Recent work in these laboratories has shown that such abnormal phenomena are apparent in the case of the sorption of polar substances such as water, formic acid, and methyl alcohol by horn keratin. Moreover, even in the case of water where the mol fraction of the absorbate is greatest for a given mass absorbed, Cassie's³ values show that there is insufficient water present in excess of the monolayer to allow the formation of groups of preferentially orientated water molecules in reasonable numbers, even for water contents so high as 20 per cent.

If the increase in dielectric constant were a function of the absorbate only, one should expect some correlation between the increase in

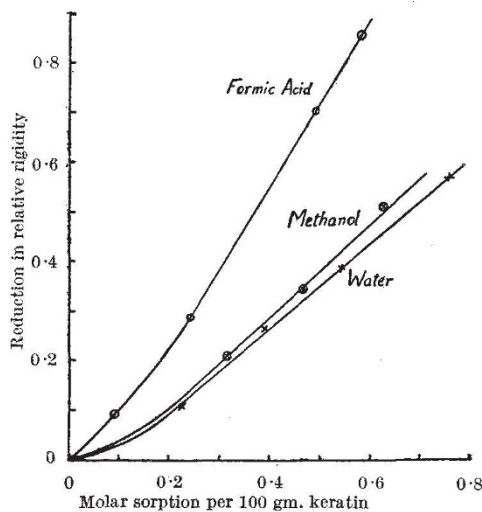


Fig. 2

dielectric constant and the dipole moment of the absorbate, assuming the increase to be due chiefly to the mobile fraction of the absorbate.

Fig. 1 shows that this is not true for all three cases investigated. For a given mol fraction absorbed, formic acid, with a dipole moment of about 1.2 E.S.U., produces a much greater increase in dielectric constant of the keratin sorbate system than either water (dipole moment 1.85 E.S.U.) or methyl alcohol (dipole moment 1.7 E.S.U.).

Fricke and his collaborators point out the connexion between the dielectric dispersion and the mechanical properties of the gelatin-water system; namely, factors which increase the dispersion give rise to increased elasticity of the gelatin. Experiment shows this to be also true for keratin. The modulus of rigidity of a wool fibre was determined by the method of torsional oscillation⁴ for increasing mol fractions of absorbate, using water, formic acid, and methyl alcohol (Fig. 2). Swelling corrections were obtained from A. T. King's⁵ results for a wool-water system, assuming similar relations to hold for the other absorbates; any errors involved should not affect the general trend of the results.

It is seen that methyl alcohol and water have roughly the same effect on both the rigidity and dielectric constant of keratin, while formic acid exhibits a greatly enhanced effect in either instance for equal molar sorption. Such evidence supports the hypothesis that increased rotation of polar groups in the polypeptide chains is responsible for both effects.

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¹ Fricke and Parker, *J. Phys. Chem.*, **44**, 716 (1940).

² Fricke and Curtis, *J. Phys. Chem.*, **41**, 729 (1937).

³ Cassie, *Trans. Faraday Soc.*, **41**, 450 (1945).

⁴ Pierce, *J. Text. Inst.*, **15**, T501 (1924).

⁵ King, A. T., *J. Text. Inst.*, **17**, T53 (1926).

Elements Occupying the Position of No. 61

A RECENT investigation has resulted in the finding of actinium¹ accumulated between neodymium and samarium magnesium nitrates after fractional crystallization; that is, between elements Nos. 60 and 62. I have carried out a separation of the above two salts, but with the addition and aid of the isomorphous bismuth magnesium nitrate. This last, using as solvent the weakest possible nitric acid, is intermediate in solubility between neodymium and samarium, and not appreciably more soluble than samarium, as when stronger acid is used. It was thus possible to reduce the neodymium-samarium intermediates from several kilograms of oxides almost to vanishing point. The products were examined by Drs. Collie and Roaf in the Clarendon Laboratory, Oxford, in 1937. The now well-established radioactivity of samarium was confirmed, but the small intermediate fractions were found to possess a stronger activity. This was eventually traced to thorium through determination of the half-life of the emanation.

Any substance possessing a slight solubility in the double magnesium nitrate solution, but tending to accumulate at the head, will also accumulate at a point where the solution suddenly becomes weaker. The saturated neodymium solution has only 40 per cent of the strength of the saturated samarium solution, so the ascending impurity is held up at the junction. Gross quantities of thorium, however, are eliminated at the tail.

Sometimes yttrium will also be found in a position between neodymium and samarium. Though its ionic radius is close to that of holmium, in atomic volume as determined from the metal density² it is slightly less than neodymium and would be greater than samarium if the decrement between neodymium and samarium was normal. Actually, however, samarium has an abnormally large atomic volume, a peculiarity which it shares with the other two lanthanates

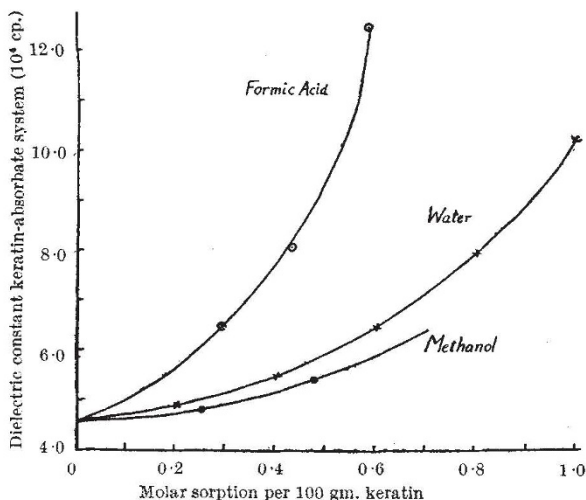


Fig. 1