LETTERS TO THE EDITORS

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Fine Structure in Polyethylene Terephthalate Fibres

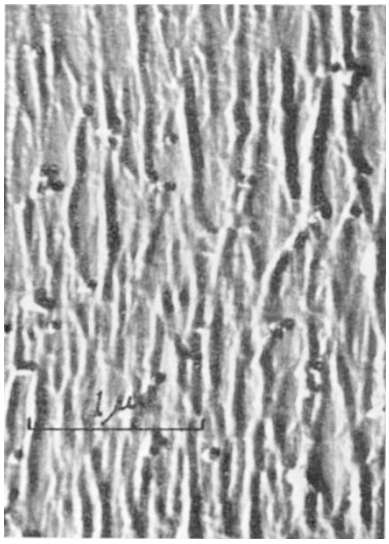
It has recently been shown by Kassenbeck[1] that drawn fibres of polyethylene terephthalate possess a surface skin, some 2500 A. in thickness. This was demonstrated by making two-stage polystyrene–silica replicas of carefully prepared sections, and photographing the replicas in the electron microscope. Kassenbeck also found that a replica taken from a region of a fibre from which the skin had been fortuitously removed revealed an unmistakable fine structure of oriented fibrils[2]. The apparent diameter of these fibrils varied between about 250 A. and 750 A.

It seemed to us desirable to follow up this work, and in particular to devise a reproducible technique for exposing the internal fine structure of drawn monofilaments. Working with comparatively thick monofilaments (0·25 mm. or more in diameter) we have succeeded in doing so.

The method consists simply in tearing open the monofilament down its length. It was thought at first that artefacts introduced by tearing might obscure the fundamental structural features of the specimen, but all the internal evidence suggests strongly that this does not happen. The structure dictates the direction which the tearing shall take, guiding it along planes of comparatively low cohesive strength, and thus the structure is revealed rather than obliterated.

For replication of the exposed surface, we used the evaporation technique, with germanium as the replicating medium. The evaporation method is simpler than that employing polystyrene and silica, as it involves only one stage: and germanium has the advantage over most of the more common replica metals that it yields completely amorphous films and does not tend to crystallize in the electron beam[3].

The accompanying photograph shows the structure revealed by this method in a drawn polyethylene terephthalate fibre. There can be little doubt of its essentially fibrillar character. The diameters of the fibrils appear to lie between about 200 A. and 1000 A., and there are several of the larger fibrils which seem to be built up of those of diameter about 200 A. This suggests that the 200-A. fibrils might be the fundamental ones, and also that there might be an upper limit, indicated by the 1000-A. fibrils, to the extent to which the fundamental fibrils can conveniently group together.



It must be pointed out that any replica technique inevitably introduces some uncertainties regarding the absolute dimensions of the original, and the figures quoted above are therefore only approximate. The results so far obtained are of qualitative, rather than quantitative, significance.

We wish to acknowledge our indebtedness to Dr. P. Kassenbeck for his generosity in discussing his results with us prior to publication. It was as a direct result of this that we turned our attention to the internal, rather than the external, structure of polyethylene terephthalate fibres. We also wish to express our thanks to Imperial Chemical Industries, Ltd., for permission to publish these results.

A. Cobbold
R. de P. Daubeny
K. Deutsch
P. Markey

Plastics Division,
Imperial Chemical Industries, Ltd.,
Welwyn Garden City,
Herts.
Sept. 7.

[1] Kassenbeck, P., *C.R. Acad. Sci., Paris*, **236**, 369 (1953).
[2] Kassenbeck, P. (private communication).
[3] Calbick, C. J., *Bell Syst. Tech. J.*, **30**, 798 (1951).

Resistant Membranes from Wool and Hair Fibres

In an investigation of the histological structure of wool and hair fibres, we have used the following technique in the preparation of sections for electron microscope examination. Sections 0·4–2·0 μ in thickness were cut of peracetic acid-treated fibres, embedded in ester wax[1]. The ribbons were transferred to water containing a little ethoxy-ethyl alcohol on a microscope slide; the slide was dried at 35° C., and the wax removed with hot xylene. The sections were treated with sodium hydroxide solution for 5–10 min., and the slide was then washed carefully with distilled water, dried, and flooded with a 0·3 per cent solution of nitrocellulose in amyl acetate. The treated sections were then stripped from the slide on the nitrocellulose support, collected and examined.

Fig. 1 is an optical micrograph of a transverse section (stained with methylene blue) of peracetic acid-treated wool after 10 min. in 2*N* sodium hydroxide solution. The boundaries of the cortical cells, the nuclei of the cells, and some fibrils were resistant to the treatment. Fig. 2 is an electron micrograph of a transverse section of peracetic acid-treated wool after treatment for 5 min. with sodium hydroxide solution. From the electron micrograph it can be seen that the resistant boundaries of the cortical cells are very thin membranes which have fallen on their sides. The membranes are creased and have some fibrils adhering to them. The examination of shadowed specimens has shown that the membranes are of the same order of thickness as