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FINE STRUCTURE IN A SMECTIC STEPPED DROP

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Résumé. — Dans une goutte à gradins de *p, p'*-di-*n*-nonyl azoxybenzène, la présence des petits gradins est visible grâce à la microscopie électronique. La hauteur de ces gradins correspond à la distance réticulaire trouvée par diffraction des rayons X.

Abstract. — In a stepped drop of *p, p'*-di-*n*-nonyl azoxybenzene in the smectic A phase, the presence of small steps can be made visible, using electron microscopy. The height of these steps corresponds to the interplanar spacing as found by X-ray diffraction.

In liquid crystals there is a long-range orientational ordering. The molecules are, on average, aligned with their long axes parallel to a preferred direction. In the nematic phase the centers of mass of the molecules are distributed at random. In the smectic A phase the centers of mass are arranged in layers. These layers have a thickness of the order of the molecular length and are perpendicular to the preferred direction. The distribution of the centers of mass is again random within the layers.

A small amount of a substance in the smectic A phase on a substrate can give a so-called stepped

drop. The drop does not have a smooth surface but consists of a series of terraces that terminate in a sharp step or edge. These steps are not of equal height and comprise many smectic layers, as was

FIG. 1. — Scanning electron micrograph of a stepped drop of *p, p'*-di-*n*-nonyl azoxybenzene. Magnification 100 x.

FIG. 2. — Transmission electron micrograph of a carbon replica of the stepped drop. Magnification 195.000 x.

found by Grandjean [1]. In this letter we report on the fine structure of these steps.

Stepped drops of *p*, *p'*-di-*n*-nonylazoxybenzene (K 45° S_A 76.5° I [2]) can be undercooled to room temperature quite easily. A photograph of such a stepped drop is shown in figure 1. The edges are distinctly visible and we wondered whether a fine structure could be made visible with the aid of electron microscopy. In order to have sufficient resolution, the thickness of the sample should not exceed about 0.1 μm. For such a thin sample the intensive electron bombardment, necessary for a high magnification, causes too high a temperature. Therefore a replica was made. First a shadowing material, for which carbon was chosen, was evaporated onto the stepped drop, at an angle of 30° with the substrate. Then the replica material, again carbon, was applied

on the rotating specimen at an angle of 45°. After dissolving the azoxy compound in acetone a replica of very low graininess was obtained. The study of this replica revealed very small steps as shown in figure 2. The height of these steps is of the order of 30 Å, corresponding to an estimated molecular length of 32.8 Å (from a Dreiding stereomodel). We also investigated the smectic phase by X-ray diffraction with Cu Kα radiation and found an interplanar spacing of 33.7 Å.

We conclude that with the aid of electron microscopy a fine structure, consisting of very small steps, can be made visible in a smectic A stepped drop. The height of these small steps corresponds approximately to the molecular length.

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