chain direction changes within the lamellae, or the straight chain traverse length must decrease towards the boundary. A change of direction seems unlikely as no discontinuity is seen within the lamellae, so we believe that the crystals taper, producing a new kind of defect structure.

This extremely clear picture of the lamellar structure in a bulk oriented polyethylene is very encouraging and raises hopes that the interior of a bulk polymer will at last become accessible to direct electron microscope examination. The method is now being applied to similar samples as part of a systematic examination. It is hoped that subsequent publications will describe both methods and results in more detail.

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Characteristics of electron-transparent regions in unthinned, rapidly quenched foils

The extremely rapid quenching of molten material, often referred to as splat-cooling, was introduced by Duwez and co-workers in 1960 [1]. Basically, the technique involves the solidification of a small amount of melt on a massive substrate. An essential feature of this method is that the molten material is very thin, thus allowing cooling rates of $10^{6\circ}$ C sec^{-1} or greater to be attained.

One of the most common techniques used is the gun technique [1, 2] in which the melt is blast-atomized onto a substrate. It was noted by Willens [3] that regions of foils produced by this technique are suitable for electron microscopy without further thinning. However, the characteristic features of these thin areas have never been investigated. It has been assumed that during the quenching process, certain droplets spread into a layer thin enough for direct electron microscopy upon striking the substrate. A necessary condition, of course, is that further droplets do not solidify on top of these films.

The morphology of electron-transparent areas in splat-cooled foils was studied and the results are presented in this short communication. A Cu–40 at.% Zr alloy was splat-cooled using the gun technique. A JEM-200 electron microscope equipped with a scanning electron microscopy attachment was used. It was possible, with this attachment, to observe the same area in the scanning transmission electron microscopy mode (STEM) and in the normal scanning electron microscopy mode (SEM). Two separate areas were observed in detail, and two different mechanisms for thin area formation were found. Fig. 1 shows an SEM of the top surface of a splatted foil in the region surrounding a transparent area. The expected overlapping of droplets is easily recognized. Fig. 2 is an STEM of the same area. The apparent process by which this electron-transparent region was formed is as follows. While a flattened molten droplet was solidifying on the substrate, another, smaller droplet (A in Fig. 1), already partially solidified, impinged upon the molten area and then rolled to the side (the substrate was not horizontal, but inclined). Owing to this impact, a considerably thinner area was left behind. The material solidified before the thinner "valley" could be filled. The fact that the small droplet remained spheroidal (droplet A) is due to the solidification of the droplet while still in flight, as pointed out by Jones [4].

The second mechanism by which an electron-transparent area in the splatted foil was produced is illustrated in Fig. 3 and 4, micrographs taken in the SEM and STEM modes, respectively. Apparently, a molten droplet was spreading across

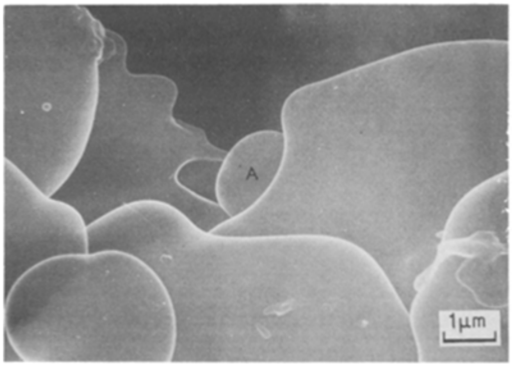

Figure 1 SEM of region surrounding an electron-transparent area.

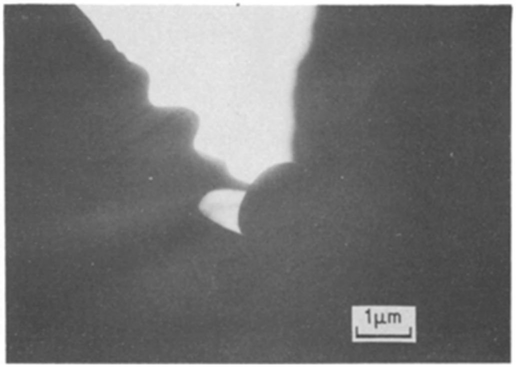

Figure 2 STEM of area corresponding to Fig. 1.

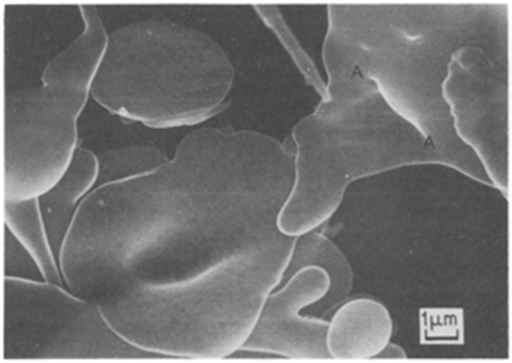

Figure 3 SEM of a second region surrounding an electron-transparent area.

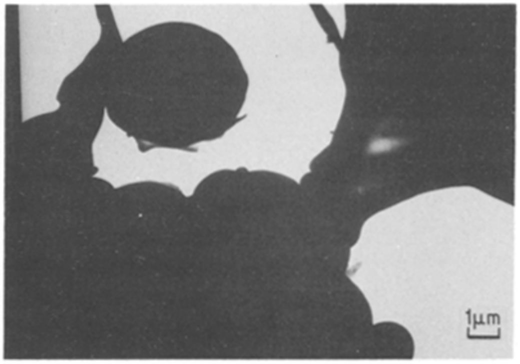

Figure 4 STEM of area corresponding to Fig. 3.

the substrate when it encountered a barrier denoted as A–A in Fig. 3. This barrier could have been due to a previously solidified droplet or a flaw in the substrate itself (the substrate was sanded before splatting to remove as much oxide as possible and allow for a faster cooling rate). Some molten material overcame this barrier, and upon spreading on the other side left the corresponding thin area.

All thin areas in the splatted foil were not observed. However, it is interesting to note that the simple mechanism of a droplet spreading on its own into an ultra-thin region was not observed, and it is suggested that this mechanism does not occur frequently, if at all. Rather, through various possible mechanisms, the thinnest areas are probably produced by interactions among droplets and between the droplets and the substrate.

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