

SINGLE-CRYSTAL-LIKE ORIENTATION OF ULTRAHIGH-MOLECULAR-WEIGHT
POLYETHYLENE BY UNIAXIAL STRETCHING

CHANG SEOUL AND SANG YONG KIM*

Department of Textile Engineering, Chonbuk National University

* Department of Textile Engineering, Seoul National University

The dried gel film of ultrahigh-molecular-weight polyethylene could be drawn to 370 times its original length at 135°C. The single-crystal mat or dried gel film of ultrahigh-molecular-weight polyethylene (UHMW PE) developed a single-crystal-like orientation in spite of uniaxial stretching. This is unique for preferentially oriented UHMW PE systems.

To elucidate the origin of the single-crystal-like orientation, the precursors with different aspect ratio were prepared and drawn uniaxially. The degree of double orientation was measured by infrared spectroscopy.

The origin of single-crystal-like orientation seems to reside in the necking region. The stacked lamellar structure is transformed into fibrillar structure in a two-dimensional fashion. This condition is easily provided when the UHMW PE single-crystal mat or dried gel film is drawn uniaxially.

The draw ratio of 40 and aspect ratio of 40 are the optimum conditions to obtain a doubly oriented structure from a UHMW PE single-crystal mat or gel film at 135°C.

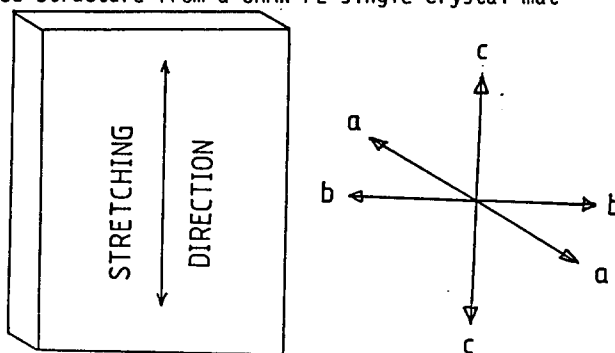


Fig.1. Schematic diagram of a single-crystal-like orientation

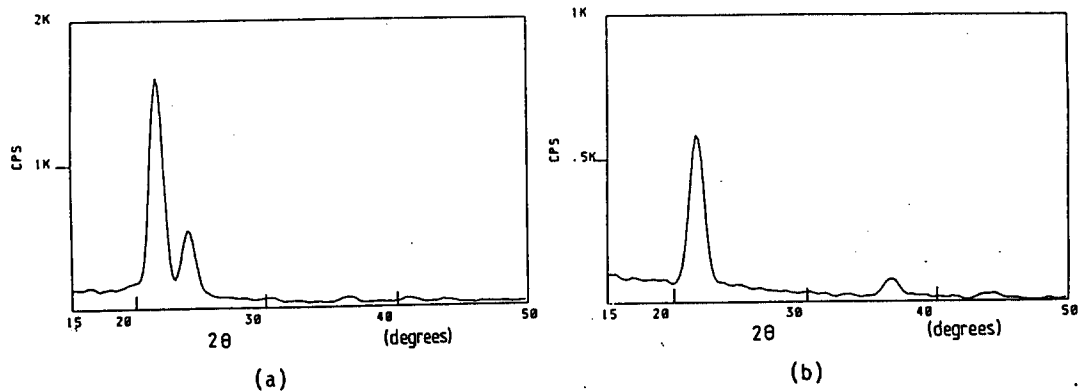


Fig.2. WAXS intensity profile of (a) the dried gel film and (b) the highly drawn film ($\times 100$) of UHMW PE along the equator of x-ray photograph (through view).

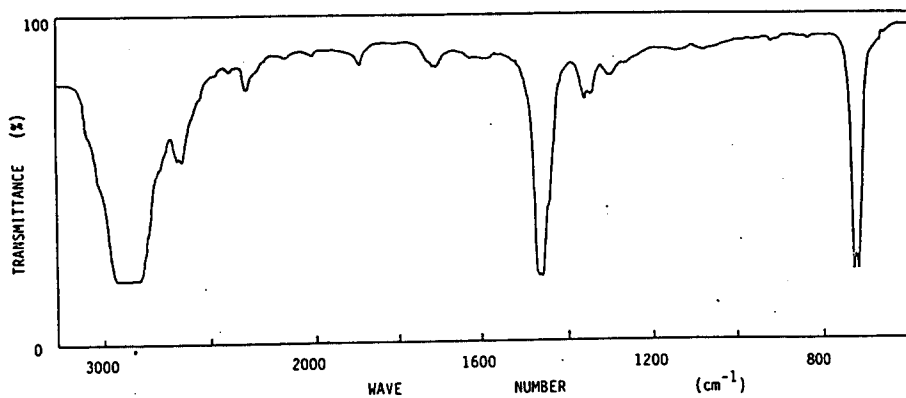


Fig.3. Infra-red spectrum of UHMW PE gel film.

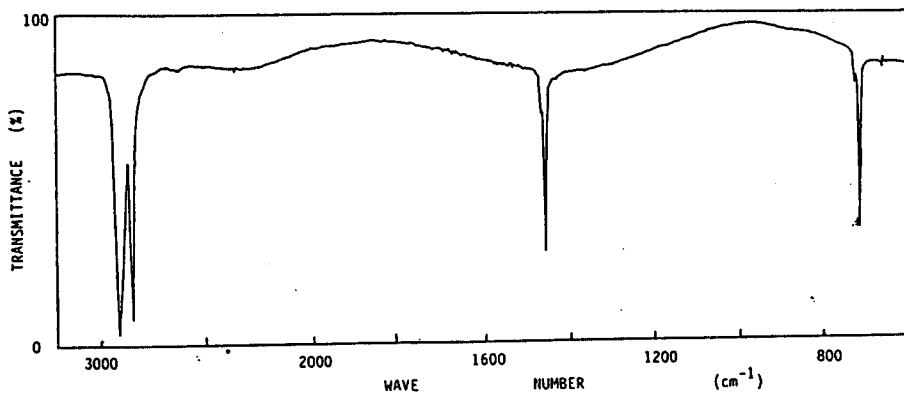


Fig.4. Infra-red spectrum of a highly drawn gel film (DR=370).