Structural Changes During Deformation of Kevlar Fibers Via On-line Synchrotron SAXS/WAXD Techniques

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Abstract No. ran4647
Beamline(s): **X3A2**

In this work, a modified Instron 4410 was adapted to the X3A2 beam line at NSLS of BNL to perform online SAXS/WAXD determinations of Kevlar 49 fiber. A unique two dimensional (2D) image analysis method was used to extract quantitative information of crystal, amorphous and mesomorphic fractions from WAXD patterns [1]. Results showed that about 20% of the fraction (mass) in the Kevlar 49 fiber was mesophase, 50% was crystalline and 30% was amorphous. There were transitions between crystal, amorphous and mesomorphic fractions during deformation. The crystal orientation was obtained in terms of the Herman's orientation function f_2 from the azimuthal scan of the (200) crystal reflection. The crystal orientation was found to be quite high in Kevlar 49 fiber and increased with the stretch ratio. The fibril length and misorientation were also obtained from 2D SAXS patterns by using the Ruland method. Results showed that the fibril length decreased with the stretch ratio until 2.0% and then increased. The misorientation decreased with increasing stretch ratio.

Reference: 1. S. Ran, X. Zong, D. Fang, B. Hsiao, B. Chu and R. Ross, "Novel Image Analysis of Two-dimensional X-r Fiber Diffraction Pattern: Example of a Polypropylene Fiber Drawing Study," J. Appl. Cryst. 33, *1031*, 2000.

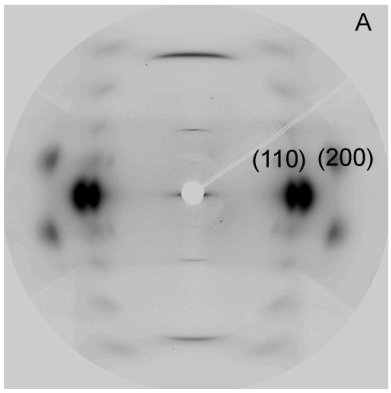

Fig 1. WAXD pattern of Kavlar 49 fiber at room temperture and a stretch ratio of 0%

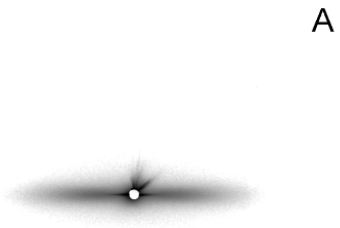

Fig 2. SAXS pattern of Kavlar 49 fiber at room temperature and a stretch ratio of 0%