Paper to be presented at the Eighth Biennial Conference on Carbon, Buffalo, New York, June 19-23, 1967.

High Strength and High Modulus Carbon Fibers*

by

Roger Bacon and W. A. Schalamon

Union Carbide Corporation
Carbon Products Division
Parma Technical Center
Parma, Ohio 44130

ABSTRACT

High strength and high modulus carbon fibers have been produced by heating carbon yarn at elevated temperatures under an applied tensile load. The section of yarn within the hot zone of the furnace stretched during this treatment, causing the graphite layers to become aligned parallel with the fiber axis. The X-ray diffraction patterns showed that a high degree of graphite layer alignment was achieved. The method proved capable of producing fibers with controllable mechanical properties, with tensile strengths ranging from 100,000 to 530,000 lbs/in^2, and with Young's moduli ranging from 9×10^6 to over 90×10^6 lbs/in^2. Mechanical properties correlated very well with the degree of applied stretch as determined by the reduction in filament cross-sectional area. The highest modulus fibers are estimated to have a density of 1.7 g/cm^3, and their modulus-to-density ratio is approximately 85 percent of the theoretical value for perfectly oriented material. A rough analysis showed that, although the elongation rate was proportional to a power of applied stress somewhat higher than unity, it did bear an inverse relationship to the degree of preferred orientation already existing in the fiber.

---

*This research sponsored in part by the Nonmetallic Materials Division, Air Force Materials Laboratory.