

POLYACRYLONITRILE FIBERS AS EMISSIVE MATERIAL

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ABSTRACT

For the first time carbon fibers were used as a field emitter in [1]. Studies have shown greater durability for carbon fibers in comparison with pointed cathode while working in a technical vacuum. Polyacrylonitrile (PAN) fibers are the most promising for the cold cathodes manufacturing. Depending on the structure, which is determined by the initial fiber and the heat treatment mode, PAN-based fibers are superior in emission current output and durability to pitch-based fibers and pyrolytic carbon fibers.

In this work, PAN fibers were studied in a scanning electron microscope, then they were used as a field cathode in a vacuum chamber. The degradation of fibers was estimated from newly taken SEM photographs. As a result of the exposure of PAN fibers in the emission chamber, various stages of destruction of the ends of individual fibers are observed. Before exposure, the fibers have a flat end with pronounced edges, and the side surface is cylindrical. After exposure as a cathode for 2 hours, the ends of some freestanding fibers acquired a conical shape and covered with deep cavities. Fiber degradation depends on the electric field strength near it during emission. Fibers bundled into beams, or those whose ends are deeper than others, change shape less than protruding or separate due to lower local electric field strength. At the same time, during prolonged exposure, the protruding fibers align with the others, and the degradation of the fibers becomes more distributed and uniform over the fiber bundle.

When studying the emission properties of PAN fibers, current-voltage characteristics were measured. The analysis of field emission images taken at different values of the emission current showed the irregular nature of the emitting surface of the carbon fiber.

References

- [1] Sheshin E.P., Ultramicroscopy, 79, (1999) 101