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DIAMETER AND TEMPERATURE CONTROL IN VAPOR-PHASE AXIAL DEPOSITION FOR OPTICAL FIBER PRODUCTION

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Abstract. *Development of a feedback control system for an industrial vapor-phase axial deposition (VAD) process and the subsequent simulated and experimental results are presented in this paper. VAD is a widely used, high purity, glass soot deposition process for the creation of optical fiber. To produce a uniform fiber, necessary for high bandwidth optical transmission and cost-effective production, it is desirable to construct diameters of the core and clad at fixed, predictable values. This VAD process for glass soot had no feedback control for deposition rate or soot surface temperature. Substrate temperature variations have been observed, leading to varying diameters of core and clad soot which subsequently reduced the usable lengths of the consolidated glass soot to be made into acceptable optical fiber, thus lowering productivity.*

Using system identification techniques, a transfer function of the process model was developed from experimental data. This empirical model was then utilized as the basis for controller design to regulate the deposition substrate temperature. Parametric design criteria for system performance and stability were used to select controller gains via graphical methods from model simulations. Simulated and experimental results both showed that measurable improvement in soot core tip temperature regulation was obtained by this control scheme. This is the first controller designed for the VAD process described, using temperature as a control surrogate for deposition rate.
Keywords: Optical fiber, Process control, Process modeling, Vapor-phase axial deposition

1. **Introduction.** Optical fiber operates on the principle of total internal reflection of light in the fiber core which has a higher refractive index than the cladding glass around the core, Figure 1. Thus, the optical fiber is a light guide, providing the highest bandwidth transfer rates for data traffic. The VAD process discussed in this work is a widely used process in the creation of high purity glass for optical fiber. VAD was invented at NTT Laboratories (Nippon Telegraph and Telephone Corporation) in Japan and is the dominant process for Japanese manufacturers of optical fiber. VAD is required to limit contaminants in the resulting glass to parts per billion. VAD is an improvement on the Corning OVD (outside vapor deposition) process [1,2]. The VAD process is one of the most cost-effective means of creating ultra-high purity glass cylinders with the required refractive index profile for optical fiber. Much has been written and documented about the VAD process [3-5]. However, developments in modeling and control of the process are