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Optimization of air-assisted CVD growth of vertically-aligned ZnO nanowires, guided by structural analysis using X-ray scattering JONG G. OK, A. JOHN HART, Mechanical Engineering, University of Michigan, Ann Arbor, MI 48109, USA — ZnO nanowires (ZNWs) are of significant interest for applications ranging from optical sensors to vibrational energy harvesters, due to properties including UV photoluminescence and piezoelectricity. We have studied low-pressure growth of ZNWs using a vapor transport method in air flowing within a tube furnace, giving vertically-aligned ZNW arrays on sapphire substrates seeded by Au catalysts. The growth rate and the average length of ZNWs depend on the flow rate of air and the total growth time, while multiple parameters such as catalyst thickness, pressure, and temperature also interdependently affect the ZNW characteristics. Grazing incidence small-angle X-ray scattering (GI-SAXS) measurements enable non-destructive quantification of ZNW diameter and alignment. By fitting GI-SAXS images using analytical models of the array as a population of solid cylinders having a Gaussian diameter distribution, we establish precise relationships between the structural characteristics and the growth conditions; for example, we determine rates of radial growth and size distribution broadening in comparison to axial growth. Control of the temperature gradient within the furnace also enables growth of well-aligned arrays at substrate temperatures as low as 600 °C.

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