Growth Behavior of ZnO on Porous Alumina by Atomic Layer Deposition

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ZnO was grown on a porous alumina support by atomic layer deposition (ALD) by using diethylzinc (DEZ) and water. The alumina support has a cylindrical shape with a length of 6.2 mm and a diameter of 1.93 mm, of which average pore diameter and specific surface area are 8.6 nm and 256 m^2/g, respectively. Although ALD is well-known as a special deposition method to achieve conformal coating on deep holes even with several tens of aspect ratio, the content of ZnO grown on the porous alumina severely decreases from that of circumferential surface of the alumina cylinder along the radial direction in spite of long exposure times of both precursors. Such a non-conformal growth behavior is attributed that the vapor pressure of DEZ decreases as the molecules internally diffuse into a longitudinal axis of the alumina cylinder. Consequently, the growth per cycle on our alumina support is limited not by a number of vacant adsorption sites via so called 'self-limiting growth mechanism' but by a number of DEZ molecules reached on the vacant sites by internal diffusion. Here we discuss the growth behavior of the internal-diffusion-limited ALD.