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Abstract
In this study, we investigated the vapor-liquid-solid (VLS) growth mechanism of low dimensional ZnO nanostructures (nanorods, NRs and nanowires, NWs) on silicon wafers. In the experiments, thermal silicon oxide layer was used as buffer layer, Au, Cu and Pt were used as catalytic agents. The growth mechanism and properties of ZnO nanorods were then discussed by controlling factors such as the amount of air flow, growth time, and growth temperature, etc. The Finite element analysis software FEMLAB was used to understand the change of convection field and temperature distribution with VLS method under different amounts of air flow and temperatures so that the relative locations of the porcelain boat and the probe can be adjusted in the experiments. After growing metal dots with a golden film in RTA under different annealing temperatures and annealing time in the two-steps growth, MATLAB was used to calculate the diameter of the metal dots and their proportion so that the most suitable parameters for growing nanostructure can be found.
The analysis results with FE-SEM, TEM, XRD and field emission I-V characterization showed that the length of ZnO nanorods increased with the growth time. Under 20 sccm, growth temperature 950℃, and a growth time of 90 minutes, the length of the nanorods were about several m, and the diameter was about 300 nm. The inspection with XRD and TEM showed that its structure is Wurtzite. Using gold as catalyst agent, the best turn-on field of field emission was 5.539 V/μm, and the largest current density was 1.097mA/cm2. Using copper as catalyst agent, the best turn-on field of field emission was 1.097mA/cm2, and the largest current density was 7.37mA/cm2. Nanowires grown in two steps have a length of 3μm and a diameter of 80nm.
Advisory Committee K. Lin - advisor

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