

Electronic supplementary information

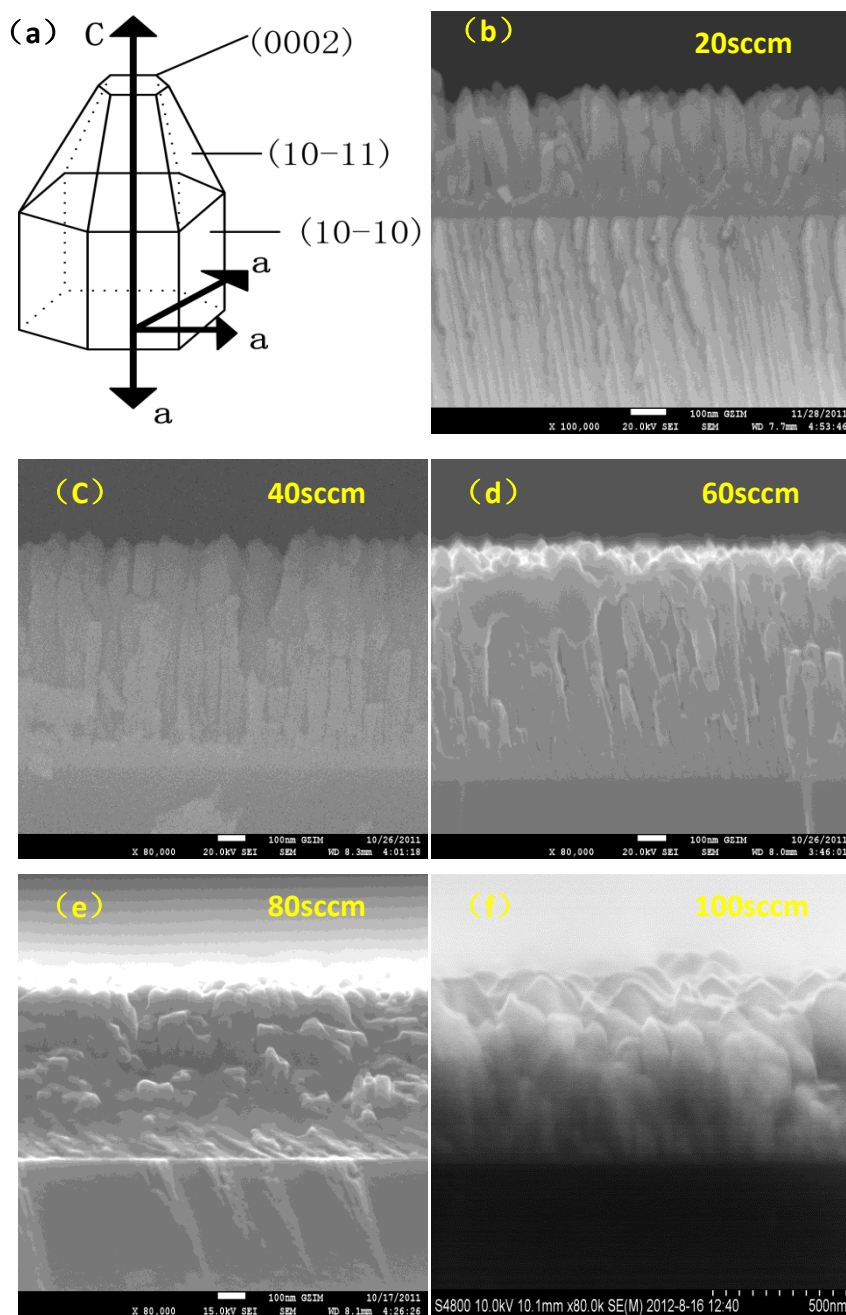


Fig.1 Schematic diagram of lattice structure (a), Cross-section SEM images of ZnO NRs grown on sapphire by MOCVD with the DEZn source MFR of 20 (b), 40 (c), 60(d),80 (e), 100 sccm (f).

Details of characterization for the samples:

X-ray diffraction(XRD) patterns were measured via a D/max - IIIA DIFFRATOMETER Instrument with Cu K_{α} radiation. SEM images were collected using JEOL JSM-7600F Field emission scanning electron microscope with 15~20KV acceleration voltage of electron beam (1st time) and Hitachi S-4800 FESEM with 10KV acceleration voltage of electron beam (2nd time). As for TEM, the JEOL JEM2100 were employed and it was operated at 200KV. The TEM sample preparation step: 1 the sample with ZnO nanostructure film was polished by mechanical thinning such as dimpling to get 20-30 μm thickness; 2 the sample was polished further by ion

milling. At this step, a hole appears almost. The edge thickness of the hole is about a few nanometers or tens of nanometer; 3 Observation of the edge of the hole by TEM. The PL measurements were performed using mini PL/Raman photon system. Its laser wavelength is 247nm.