Ag was used as catalyst for growth of vertical ZnO nanorods. Moreover, Ag also acts as an amphoteric dopant, existing both on substitutional Zn sites and in the interstitial sites, as substitutional acts as acceptor. Therefore, the effects of Ag on the optical properties of ZnO is of importance. We have grown the ZnO microrods by MOCVD with Ag catalyst on Si (100) substrates at Ts = 773 K. The elongated quasi single crystal structures were observed to have corrugated side facets.

The presence of SFs affects the luminescence properties of ZnO by creating additional peak at 3.321 eV (at 4 K). This peak co-exists with the common donor bound excitonic (D0X) and free excitonic recombination’s peaks as well as their respective phonon replicas (Fig. 1). Furthermore, the SFs related peak is stable at least up to 350 K, providing splitting of the near band edge emission of ZnO into two peaks: FX emission appears at 375 nm and this of SFs at 386 nm (Fig. 2). Therefore, visualizing of the two emissions was performed by CL mapping: the two types of emission are spatially resolved. These radiative recombination processes are under investigation by time-resolved PL. It is proposed, that at high Ag concentrations, the SFs formation is favored.

High concentrations of basal SFs were found to be responsible for the surface corrugation. A TEM study of the cross-section of ZnO/Ag/Si has revealed additional unusual contrast in bright field mode. The featured lines were located parallel to the substrate plane, e.g. perpendicular to the c-axis of the NR. Presuming that the reason for this is the extended defects, we have studied individual NRs by HRTEM. A number of basal plane [0001] stacking faults were observed, penetrating the NRs perpendicular to its c-axis (Fig. 3). BSFs were found to be quasiperiodically inserted every 5 - 10 nm along the NRs. It has to be mentioned that SFs are observed in both types of NRs. We attribute the appearance of BSFs as due to the Ag dopants.

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Fig. 1: LT PL spectrum (4 – 100 K) of ZnO:Ag microrods (the SEM image is as inset).

Fig. 2: The micro-PL spectra taken along the microrod: the transition of the PL intensity from UV to Blue emission is shown. The light emissions are visualized by CL mapping (inset).

Fig. 3: High concentration of basal SFs were found to be responsible for the surface corrugation as it is seen in the HRTEM image.