Photoluminescence Spectra of Sample H1101b and Sample H1101e

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1 Background Information

Two samples of ZnO nanowires on sapphire substrates were grown by Chris Coutts during the week of June 22, 2020. On Friday June 26, PL spectra were taken of these two samples, labeled H1101b and H1101e respectively. The samples differ by their level of exposure to N2O: sample H1101b had 2 minutes of exposure and sample H1101e had 5 minutes of exposure. The data was taken with a spectrometer slit width of 20 μm and with the sample at 3.7(7) K.

2 Graphs

After calibrations and optimizations, a representative PL spectrum of sample H1101b was taken and is shown in Fig. 1. Here, the sample was tilted and the laser spot was on the edge of the sample. The broad peak corresponding to surface excitons is at 3366.5 meV with 85 000 counts. The sharp and narrow indium peak is at 3356.6 meV with 92 000 counts. The smaller peaks (eg. gallium) off of the shoulder of the broad surface-exciton peak are at 3359.7 meV and 3361.0 meV. Previous spectra collected that day had very similar features, but had less count optimization.

Figure 2 shows the subsequent two PL spectra of sample H1101e. The spectrum labeled 0 was taken at a peculiar spot on the sample, on a ridge or edge of some kind. Spectrum 1 was taken on a spot below the ridge. Both spectra now show a sharp peak emerging from the broad surface-exciton peak. This is likely the indium ion peak. It is at 3367.5 meV with 72 000 counts on spectrum 0 and at 3367.5 meV with 95 000 counts on spectrum 1. This is evidence that the spectrometer calibration is shifting left, likely from missing motor steps.

It also shows the relative intensity of this broad peak is higher in spectrum 1. The indium peaks are at 3356.6 meV and 3356.7 meV for spectrum 0 and 1 respectively. Both spectra show an intensity of around 130 000 counts for that narrow peak. The smaller peaks (eg. gallium) are at 3359.7 meV and 3361.1

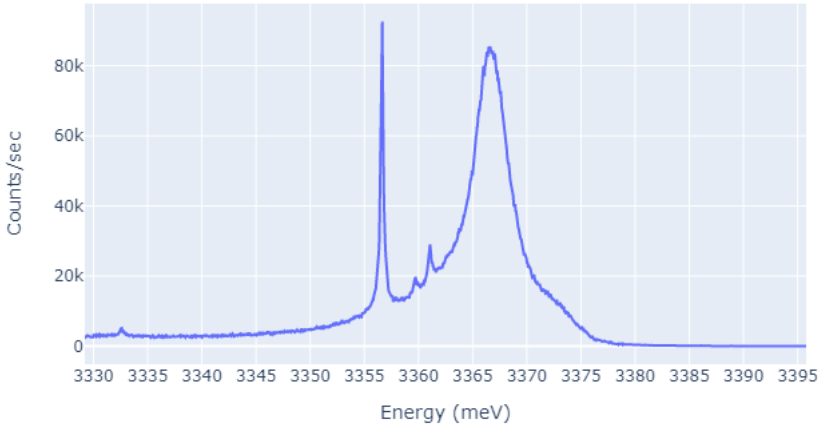

Figure 1: PL spectrum of sample H1101b of ZnO nanowires on sapphire.

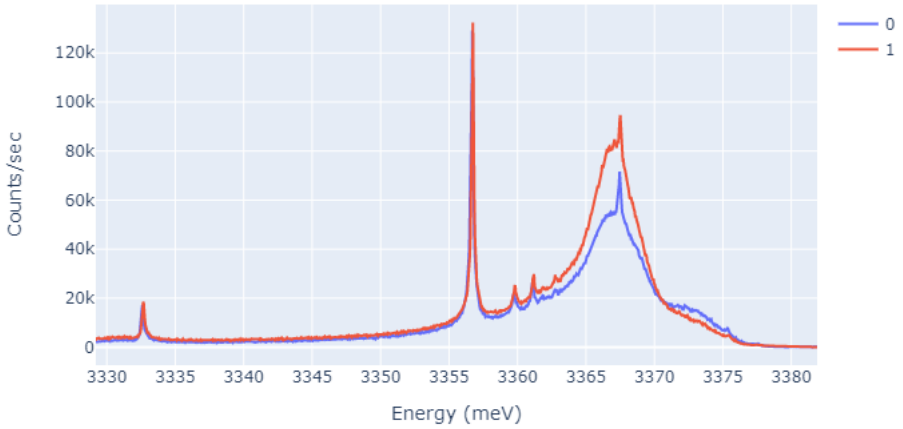

Figure 2: PL spectra of sample H1101e of ZnO nanowires on sapphire.

meV for spectrum 0. They are at 3359.8 meV and 3361.2 meV for spectrum

1. The Y-line is at 3332.6 meV and 3332.7 meV for spectrum 0 and spectrum 1 respectively. The peak is at around 18 000 counts for both spectra. This is in stark contrast to the 5 000 counts seen on the sample H1101b spectrum at 3332.6 meV.

Table 1 shows a summary of the peak positions in wavelengths for all three spectra across the two samples. There is an identifiable shift in the spectra, each were taken one after the other.

Table 1: The wavelengths (in meV) of the peaks in the ZnO spectra for samples H1101b and H1101e

Spectrum	Surface Exciton	In ion	Ga and other smaller peak	In	Y-line
H1101b	3366.5	-	3361.0, 3359.7	3356.6	3332.6
H1101e (0)	-	3367.5	3361.1, 3359.7	3356.6	3332.6
H1101e (1)	-	3367.5	3361.2, 3359.8	3356.7	3332.7

3 Data Access

For an online version of the graph were cursors are available, please visit the simwat/symphony github repository, under the PLE/June26 folder. Run the Python 3 program. You can select an area to zoom in.