

Orientation-Mediated Luminescence Enhancement and Spin-Orbit Coupling in ZnO Single Crystals

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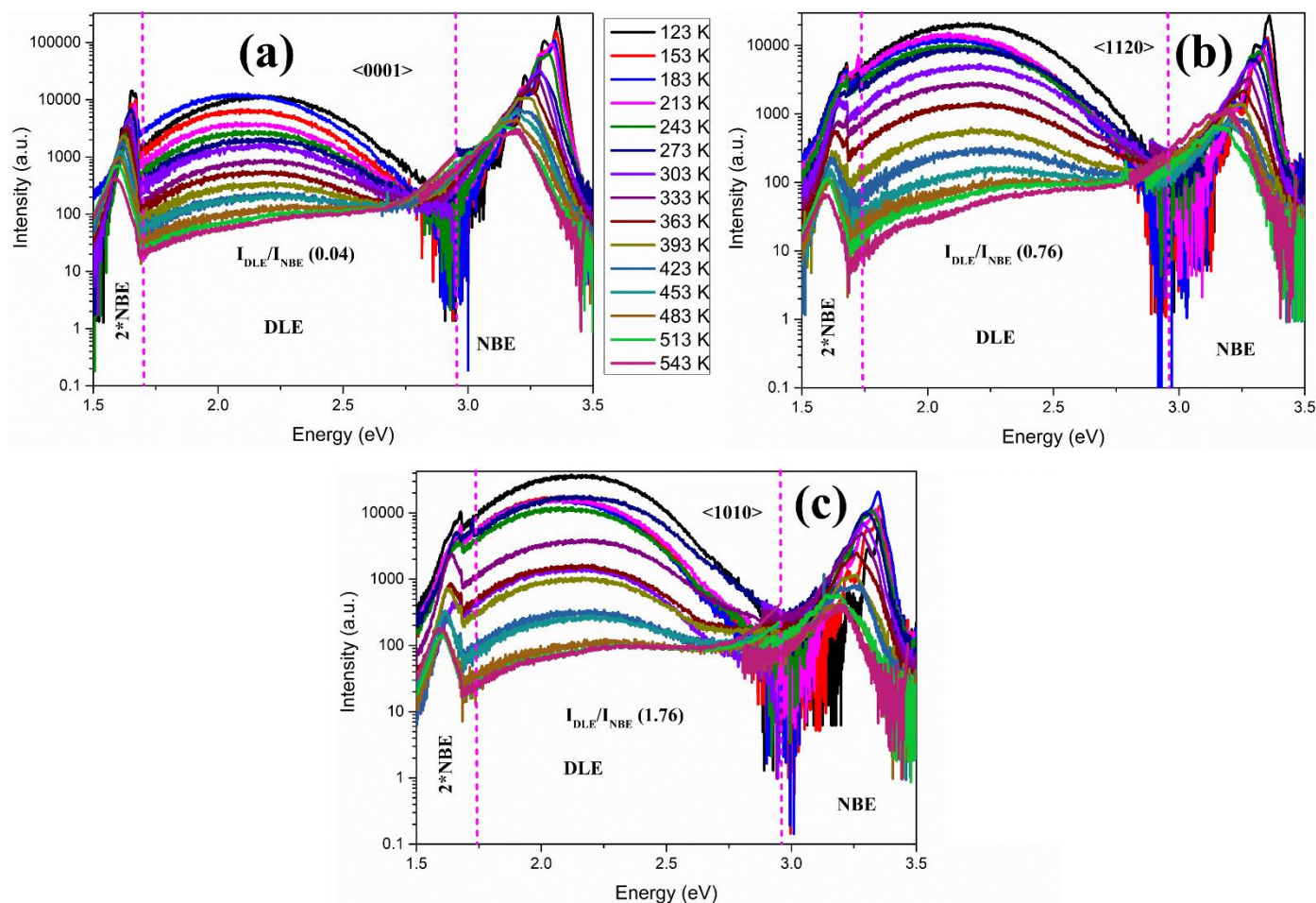


Figure S1: Complete scan of temperature-dependent photoluminescence spectra of (a) <0001> (b) <1120> (c) <1010> orientation of ZnO single crystals measured with 320 nm excitation wavelength over the temperature range of 123-543 K. Here NBE and DLE represents the near-band-edge and deep level emission, respectively. I_{NBE} and I_{DLE} denotes the intensity of NBE and DLE.

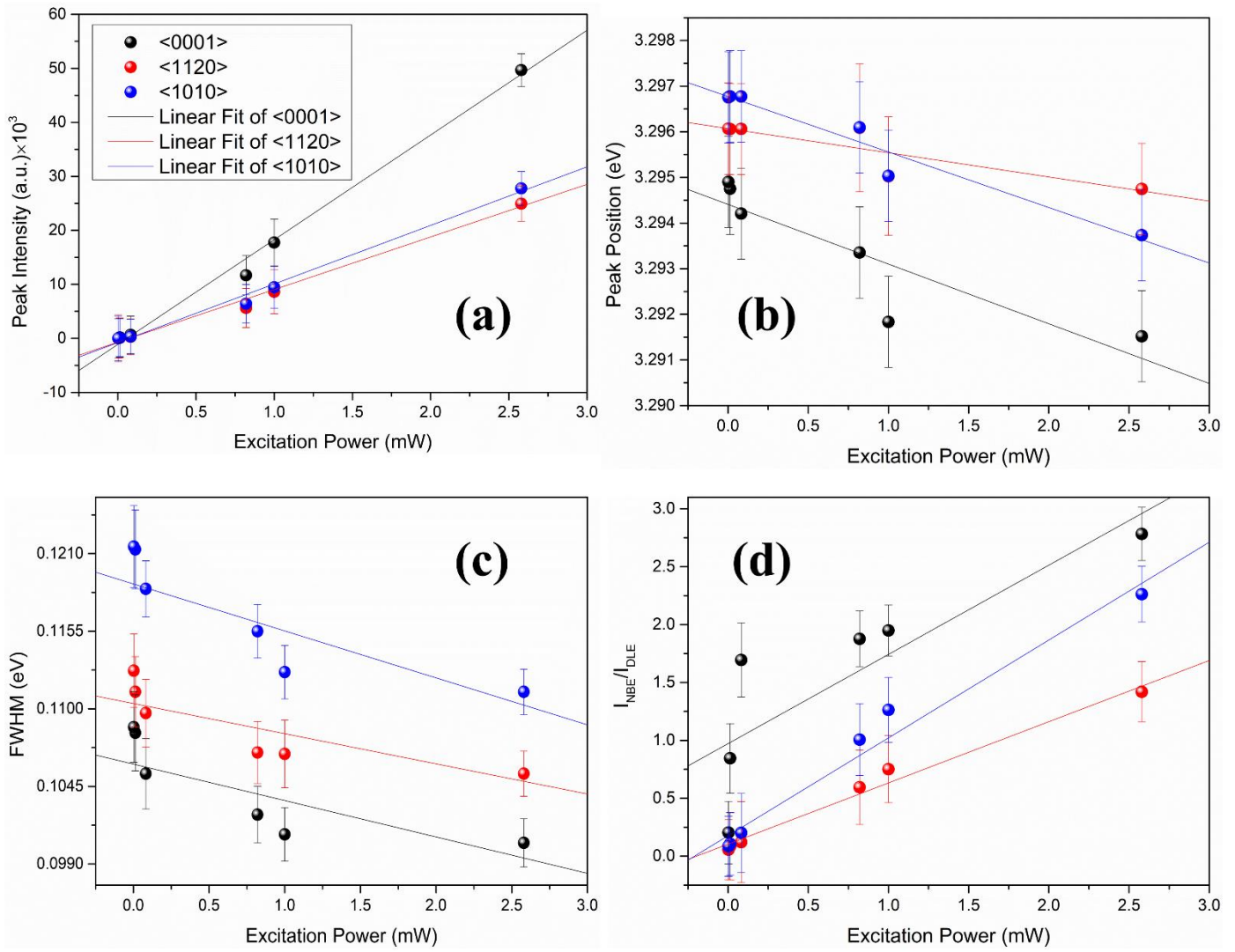


Figure S2:The relationship between (a) peak intensity (b) peak position (c) FWHM (d) ratio of NBE/DLE intensity as a function of excitation power for ZnO single crystals with three distinct orientations . The solid lines represent a linear fit of the experimentally observed data points, while the black, red, and blue solid spheres represent experimentally observed data of $\langle 0001 \rangle$, $\langle 1120 \rangle$, and $\langle 1010 \rangle$ ZnO single crystals.

Table S1: Room-temperature PL peak position, intensity ratio and the Varshni's fit parameters for ZnO single crystals with different orientations.

Orientation Type	NBE Peak Position (eV)	DLE Peak Position (eV)	$I_{\text{DLE}}/I_{\text{NBE}}$	α (eV/K)	β (K)
$\langle 0001 \rangle$	3.28	2.17	0.074	0.00104	897
$\langle 1120 \rangle$	3.29	2.15	1.434	0.00102	928
$\langle 1010 \rangle$	3.29	2.15	1.705	0.00109	1016