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Extinction of the zero-phonon line and the first-order phonon sideband in excitonic luminescence of ZnO at room temperature: the self-absorption effect

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Abstract:

It is firmly demonstrated in experiment that the self-absorption (SA) effect can lead to the extinction of the zero-phonon line and the first-order longitudinal optical phonon sideband of free excitonic luminescence of ZnO at room temperature. Moreover, effectiveness degree of SA effect is found to be dependent on both absorption coefficient and travelling distance of emitted photons, as well as even lattice temperature, which is uniquely reflected by the redshift amount in emission peak in ZnO. It is also unambiguously proved that the SA effect still strictly obey the Beer-Lambert law of absorption. This work not only uncovers the long-term puzzle of significant redshift of emission peak of ZnO at higher temperatures, but also shows that the SA effect may have to be carefully taken into consideration in the study of spontaneous emission, laser and relevant optoelectronic processes in luminescent materials and optoelectronic devices.

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