Ultrafast Spectroscopy in Novel Nanomaterials

Lazaro A. Padilha
Physics Institute, Universidade Estadual de Campinas, Campinas, SP 13083-859, Brazil
Tel.:55-19-3521-5432, E-mail: padilha@ifi.unicamp.br

In recent years, the use of LED panels have drastically increased due to novel technologies such as smartphones and tablets. Following this crescent trend the search for materials, which could perform as the ideal platform for brighter LED´s with better color resolution, has been taking the attention of many groups in academia and industry. Among those candidate materials, semiconductor nanostructures have shown some advantages such as color tunability and selectivity due to the relatively narrow emission width. The first attempts to make quantum dots based LEDs resulted in very poor efficiencies due to losses originated from efficient non-radiative electron recombination pathways.[1, 2] Using ultrafast spectroscopy it was possible to identify those pathways and engineer novel nanomaterials with improved performance. Here we will discuss the insights of ultrafast spectroscopy on the recent advances of semiconductor nanomaterials with reduced non-radiative decay channels, in particular Auger recombination, and high emission yield.

Core/Shell nanostructures have emerged as a promising way to overcome the Auger losses by delocalizing the electron wavefunctions,[3] which could be even further improved in Core/Alloy/Shell structures.[4] It has been recently shown that external quantum efficiency up to about 8% in QD-LED can be obtained with CdSe/CdSSe/CdS and CdSe/CdS/ZnS multi-shell structures.[5, 6]

.

References

1. J. M. Caruge, J. E. Halpert, V. Wood, V. Bulovic and M. G. Bawendi, Nat Photon **2** (4), 247-250 (2008).
2. V. L. Colvin, M. C. Schlamp and A. P. Alivisatos, Nature **370** (6488), 354-357 (1994).
3. S. Brovelli, W. K. Bae, C. Galland, U. Giovanella, F. Meinardi and V. I. Klimov, Nano Letters **14** (2), 486-494 (2014).
4. W. K. Bae, L. A. Padilha, Y.-S. Park, H. McDaniel, I. Robel, J. M. Pietryga and V. I. Klimov, ACS Nano **7** (4), 3411-3419 (2013).
5. W. K. Bae, Y.-S. Park, J. Lim, D. Lee, L. A. Padilha, H. McDaniel, I. Robel, C. Lee, J. M. Pietryga and V. I. Klimov, Nature Communications **4** (2013).
6. J. Kwak, W. K. Bae, D. Lee, I. Park, J. Lim, M. Park, H. Cho, H. Woo, D. Y. Yoon, K. Char, S. Lee and C. Lee, Nano Letters **12** (5), 2362-2366 (2012).