



# 2021「中技社科技獎學金」

## 2021 CTCI Foundation Science and Technology Scholarship

### 境外生研究獎學金

Research Scholarship for International Graduate Students

## Designing of Broadband Near-Infrared Phosphors for Spectroscopy Applications



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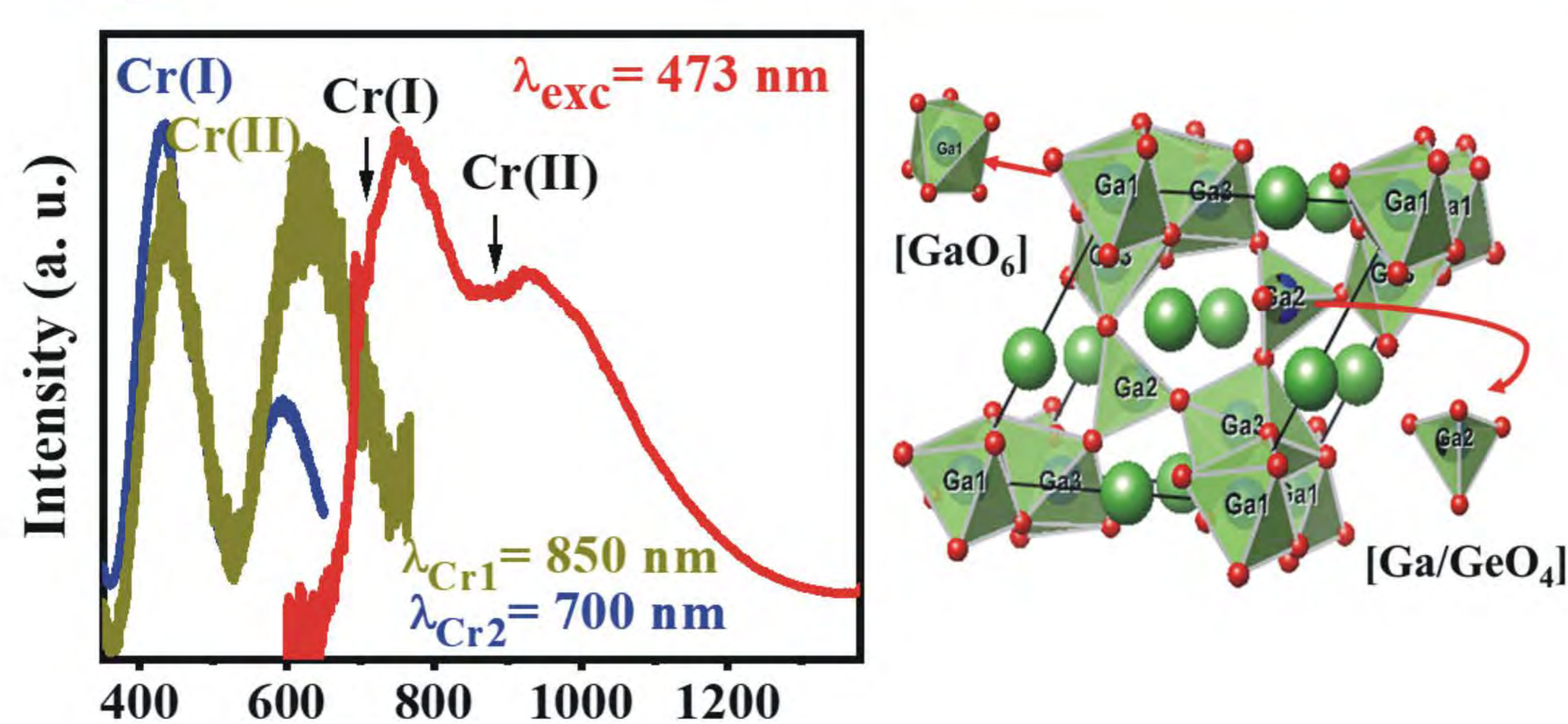
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### Abstract

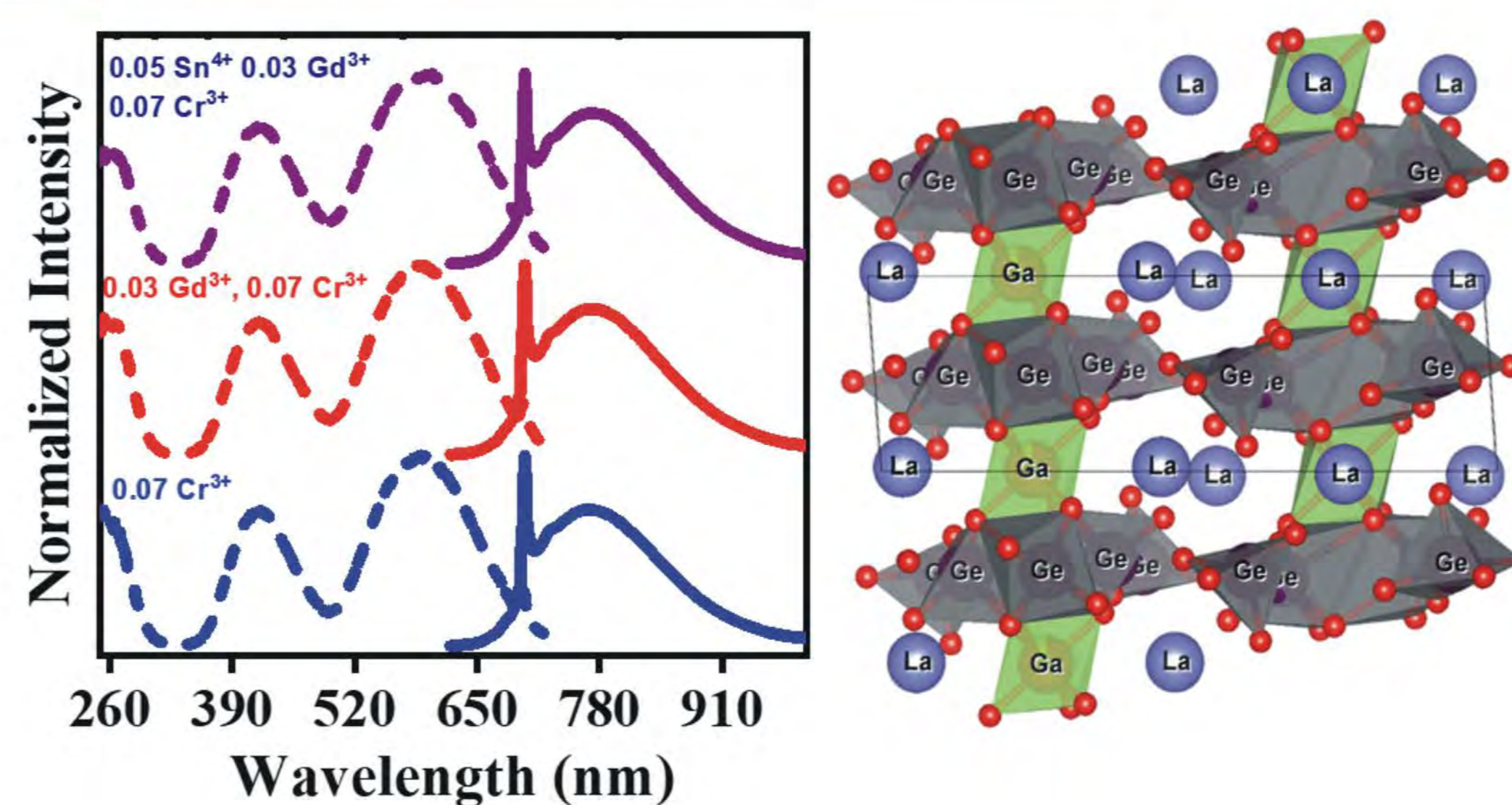
The near-infrared light (NIR) source based on the phosphor-converted light-emitting diode (pc-LED) seems can be a promising candidate for the upcoming compact NIR devices than traditional light sources due to its low cost, versatility, and temperature characteristics. We designed three different chemical systems such as  $\text{La}_3\text{Ga}_5\text{GeO}_{14}:\text{Cr}^{3+}$ ,  $\text{La}_3\text{GaGe}_5\text{O}_{16}:\text{Cr}^{3+}, \text{Gd}^{3+}, \text{Sn}^{4+}$ , and  $\text{SrAl}_{12-x}\text{Ga}_x\text{O}_{19}:\text{Cr}^{3+}$  for the broadband emission in the range of 650–1200 nm. The potential of the proposed systems is demonstrated by the fabrication of pc-NIR LED devices and performances are evaluated with the values of radiant flux. The luminescence mechanism of these three chemical systems is proposed based on the number of active luminescence centers, and the formation of luminescence pairs. These systems provide a clear understanding to design the next-generation NIR phosphor.

### Research Focus

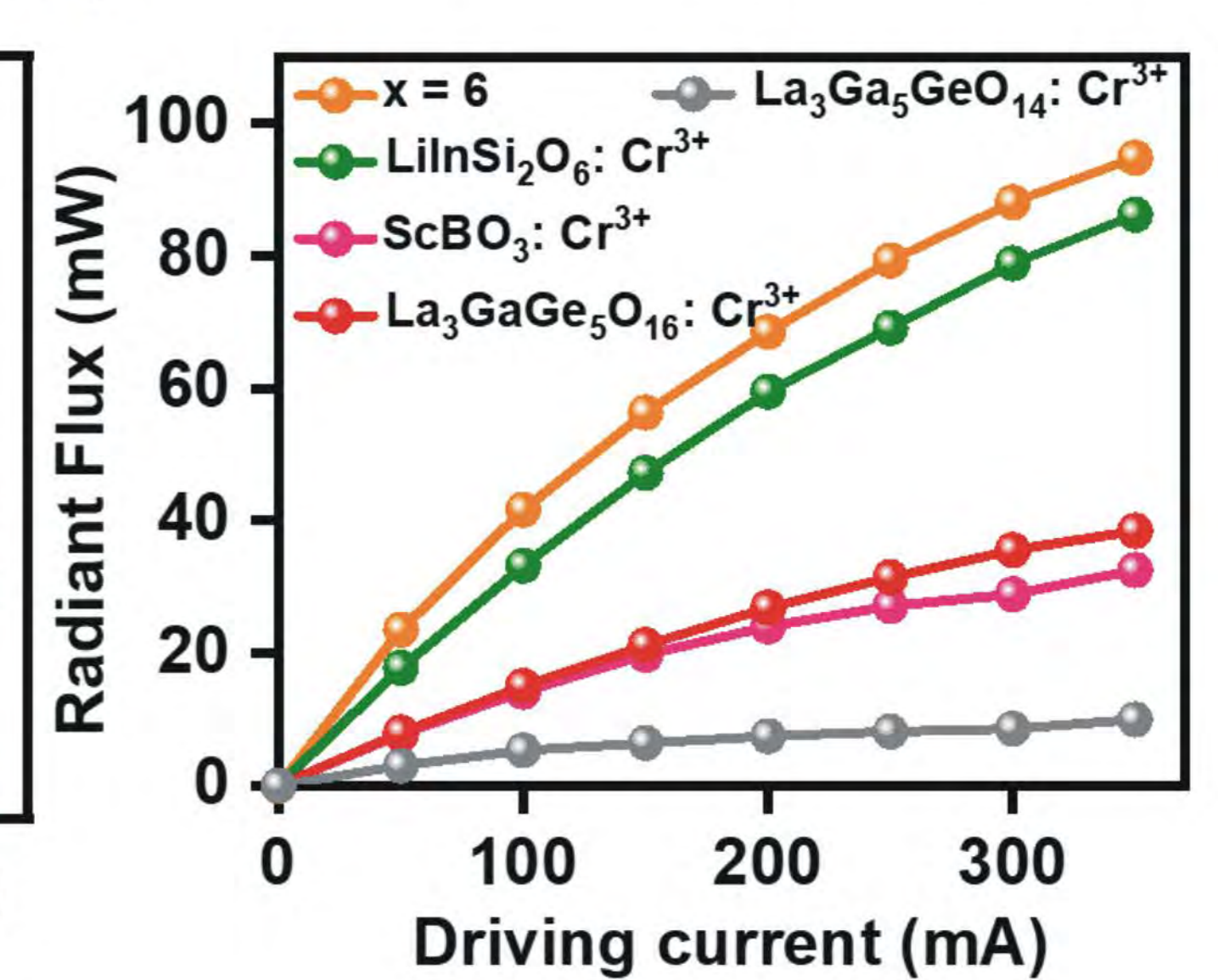
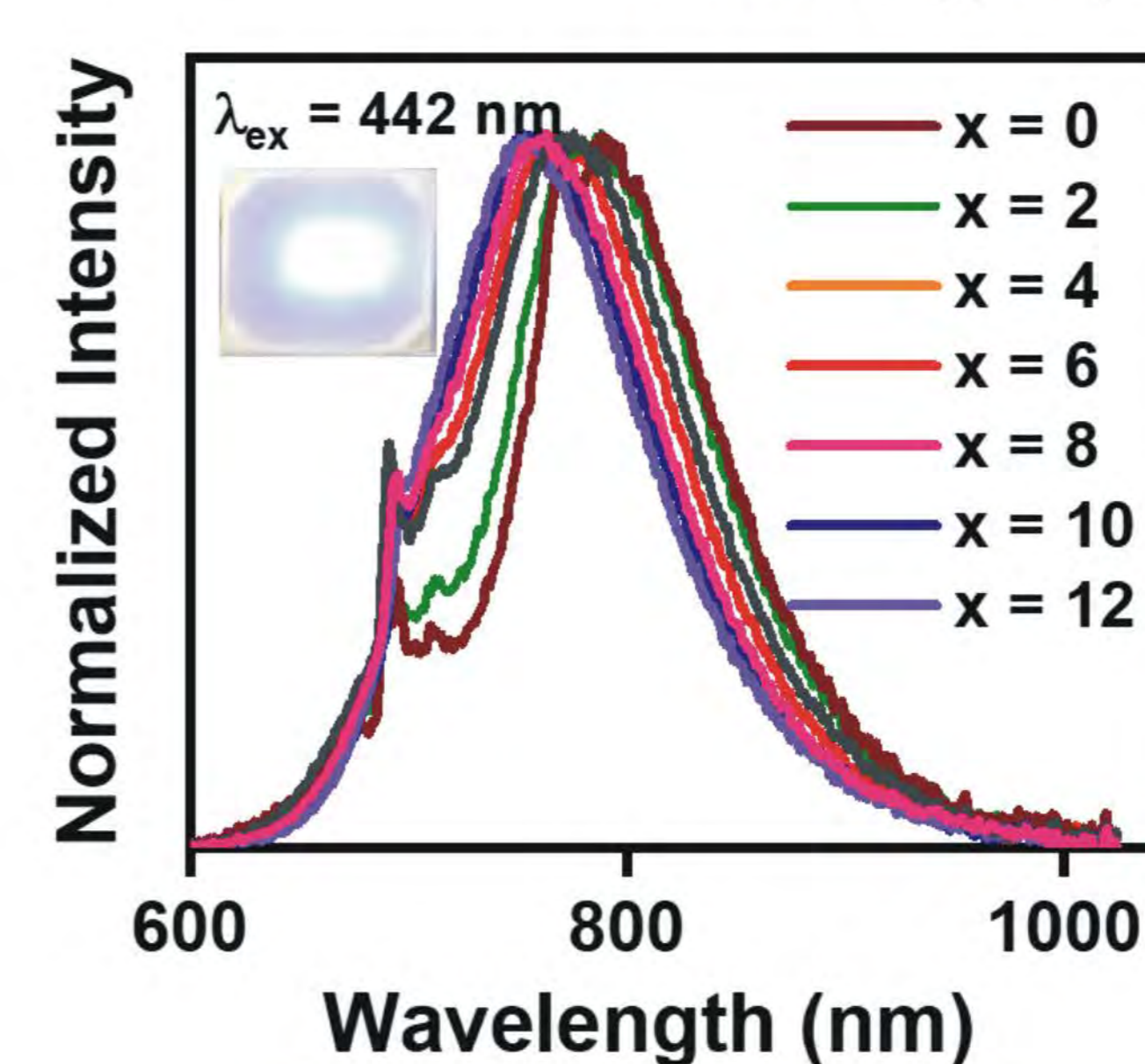
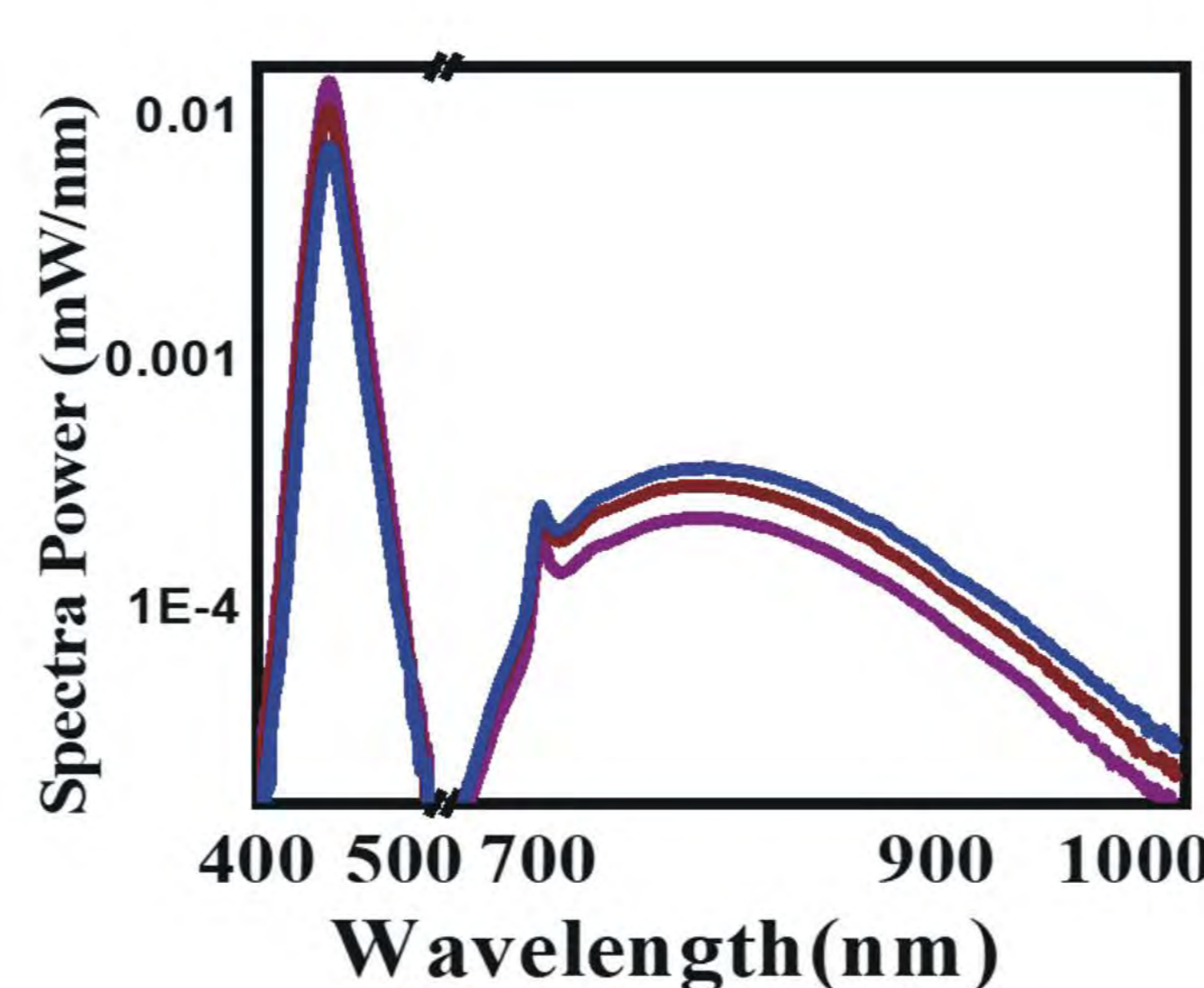
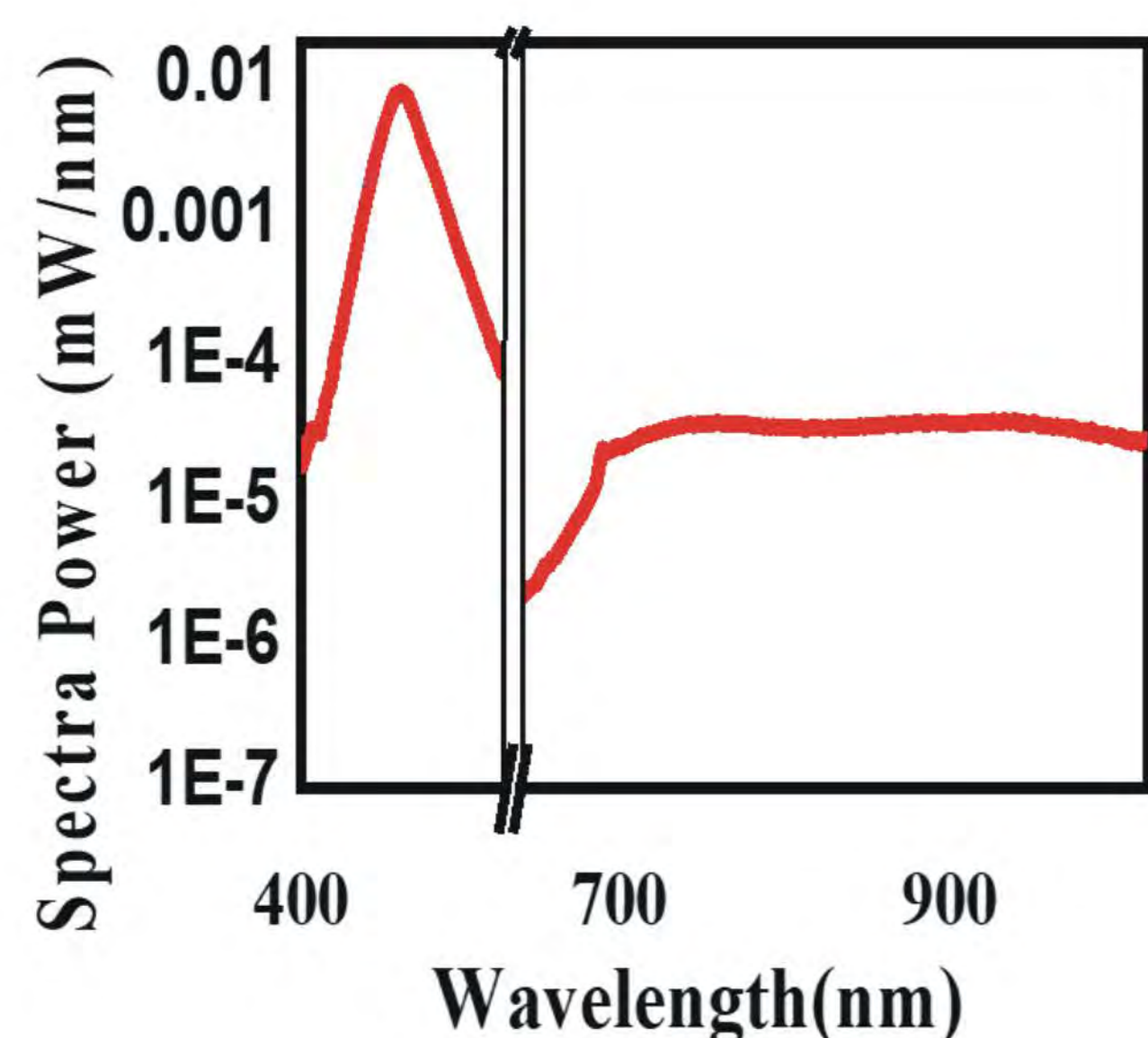
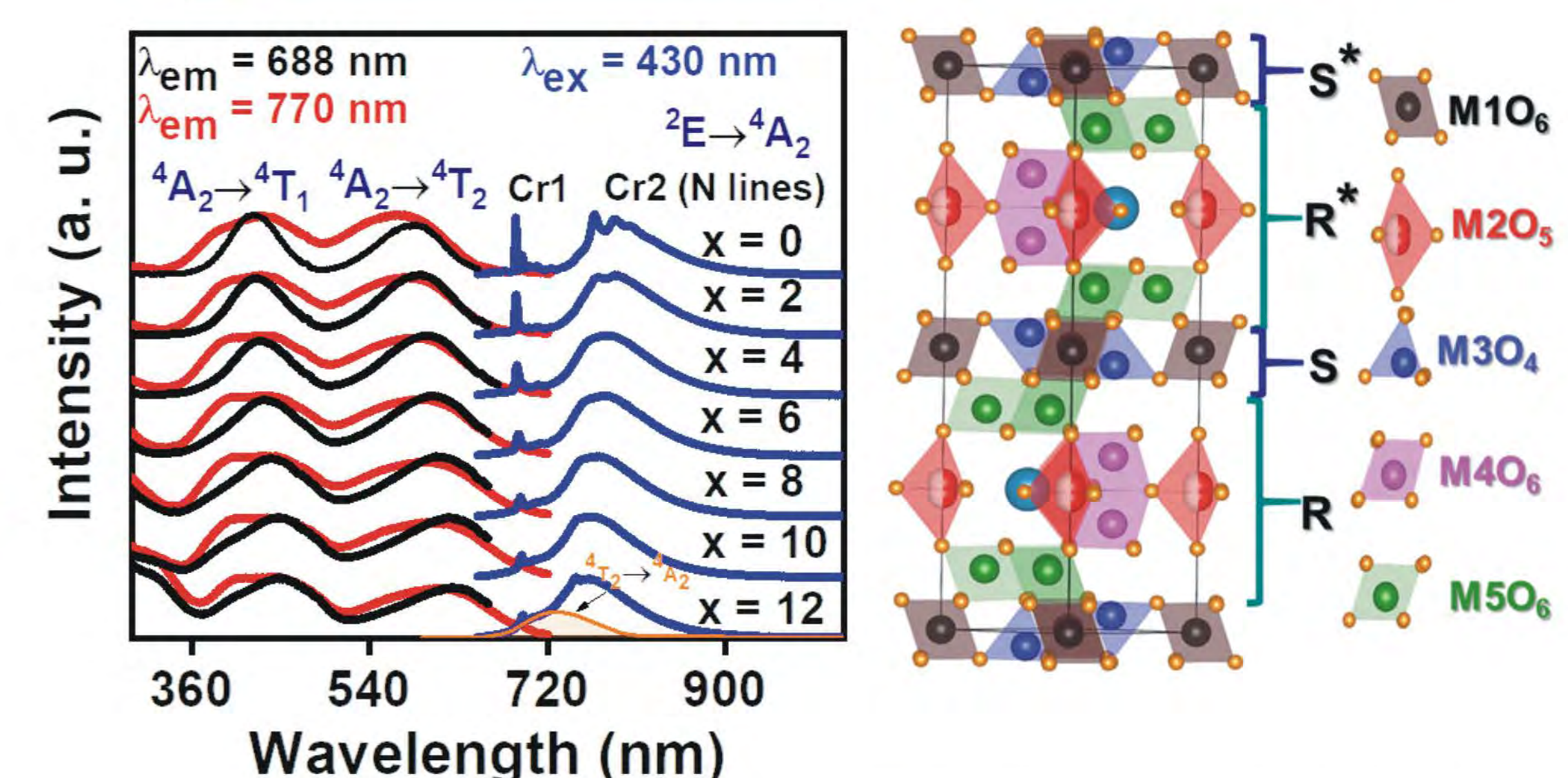
#### $\text{La}_3\text{Ga}_5\text{GeO}_{14}:\text{Cr}^{3+}$



#### $\text{La}_3\text{GaGe}_5\text{O}_{16}:\text{Cr}^{3+}, \text{Gd}^{3+}, \text{Sn}^{4+}$



#### $\text{SrAl}_{12-x}\text{Ga}_x\text{O}_{19}:\text{Cr}^{3+}$



### Selected Publications

- 1) Rajendran, V.; Fang, M. H.; Guzman, G. N. D.; Lesniewski, T.; Mahlik, S.; Grinberg, M.; Leniec, G.; Kaczmarek, S. M.; Lin, Y. S.; Lu, K. M.; Lin, C.M.; Chang, H.; Hu, S. F.; Liu, R. S., Super Broadband Near-infrared Phosphors with High Radiant Flux As Future Light Sources for Spectroscopy Applications, *ACS Energy Lett.* **2018**, *3*, 2679–2684.
- 2) Rajendran, V.; Lesniewski, T.; Mahlik, S.; Grinberg, M.; Leniec, G.; Kaczmarek, S. M.; Pang, W.K.; Lin, Y. S.; Lu, K. M.; Lin, C.M.; Chang, H.; Hu, S.F.; Liu, R.S., Ultra-Broadband Phosphors Converted Near-Infrared Light Emitting Diode with Efficient Radiant Power for Spectroscopy Applications, *ACS Photonics*, **2019**, *6*, 3215–3224.
- 3) Rajendran, V.; Chang, H.; Liu, R.S. Recent Progress on Broadband Near-infrared Phosphors-converted Light Emitting Diodes for Future Miniature Spectrometers, *Opt. Mater. X* **2019**, *1*, 100011.
- 4) Rajendran, V.; Fang, M. H.; Huang, W. T.; Majewska, N.; Lesniewski, T.; Mahlik, S.; Leniec, G.; Kaczmarek, S. M.; Pang, W. K.; Peterson, V. K.; Lu, K.-M.; Chang, H.; Liu, R.-S. Chromium Ion Pair Luminescence: A Strategy in Broadband Near-Infrared Light-Emitting Diode Design. *J. Am. Chem. Soc.* **2021**, *143*, 19058–19066.
- 5) Patent: "Phosphor, Method for Preparing Phosphor, Optoelectronic Component, and Method for Producing Optoelectronic Component"—US10683454B2 dated 16 June 2020.



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