

Supporting Information

Enhancing luminescence performance of $\text{Ca}_{2-x}\text{Sr}_x\text{BO}_3\text{Cl}:\text{Eu}^{2+},\text{Dy}^{3+}$ by substitution of Sr^{2+} for Ca^{2+} (TC-ART-06-2022-002382.R1)

*Junlong Cao^a, Songsong Ding^a, Yunpeng Zhou^a, Xilin Ma^a, Yuhua Wang^{*a}*

^a National and Local Joint Engineering Laboratory for Optical Conversion Materials and Technology of National Development and Reform Commission, Department of Materials Science,
Cross-Strait Research and Technology Transfer Center for Optoelectronic Materials & Devices of Lanzhou University and Taiwan Kun Shan University,
School of Materials and Energy, Lanzhou University, No. 222, South Tianshui Road,
Lanzhou, Gansu, 730000, P. R. China.

*Corresponding author' email: wyh@lzu.edu.cn

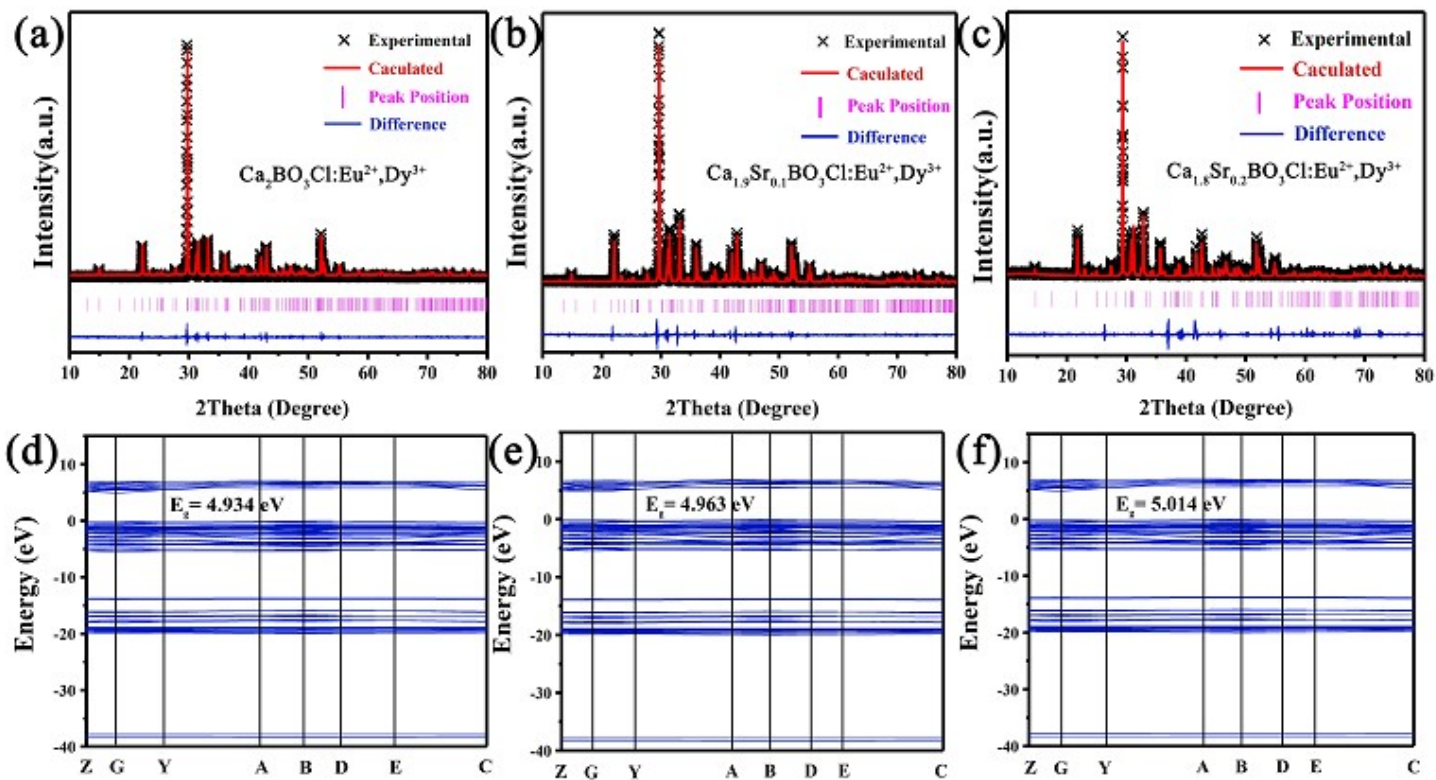


Figure S1. The XRD Rietveld refinement spectra of a) $\text{Ca}_2\text{B}_3\text{Cl}$; b) $\text{Ca}_{1.9}\text{Sr}_{0.1}\text{BO}_3\text{Cl}$; c) $\text{Ca}_{1.8}\text{Sr}_{0.2}\text{BO}_3\text{Cl}$; The band structure of d) $\text{Ca}_2\text{BO}_3\text{Cl}$; e) $\text{Ca}_{1.9}\text{Sr}_{0.1}\text{BO}_3\text{Cl}$; f) $\text{Ca}_{1.8}\text{Sr}_{0.2}\text{BO}_3\text{Cl}$.

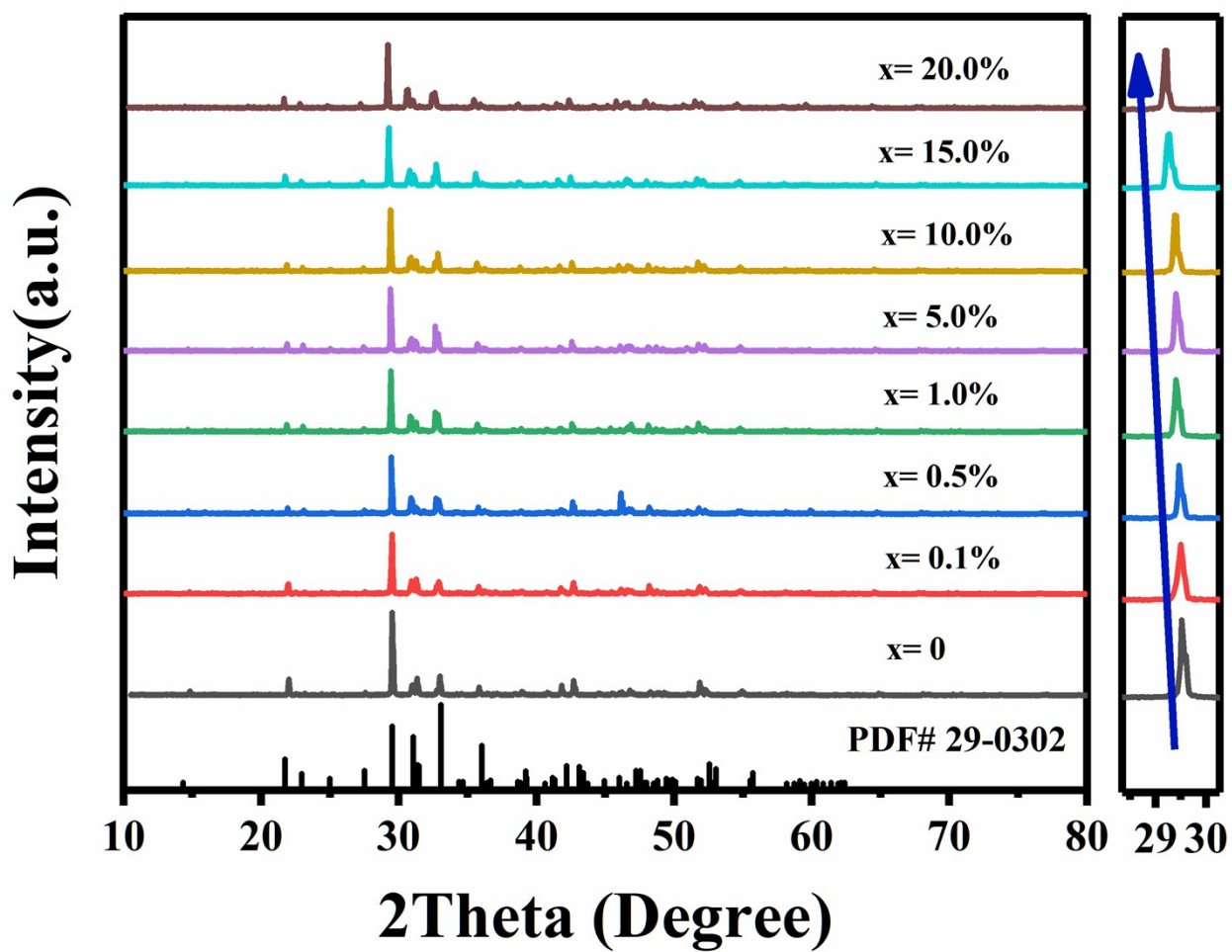


Figure S2. The XRD spectra of $\text{Ca}_{2-x}\text{Sr}_x\text{BiO}_3\text{Cl}:\text{Eu}^{2+}, \text{Dy}^{3+}$.

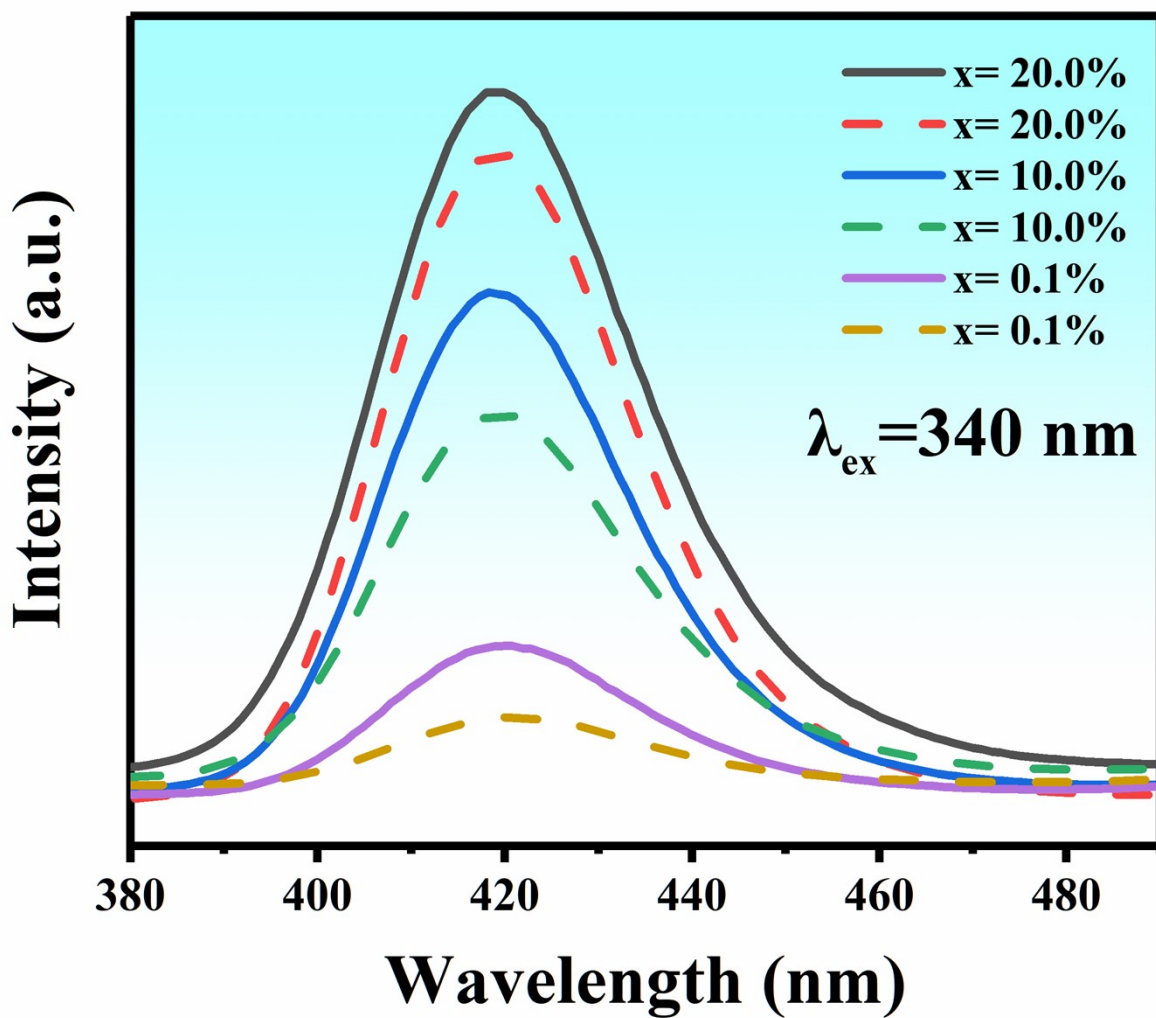


Figure S3. Comparison of the characteristic emission of $\text{Ca}_{2-x}\text{BO}_3\text{Cl}$ ($x=0,10\%,20\%$) oxygen vacancies in reducing atmosphere and vacuum atmosphere.

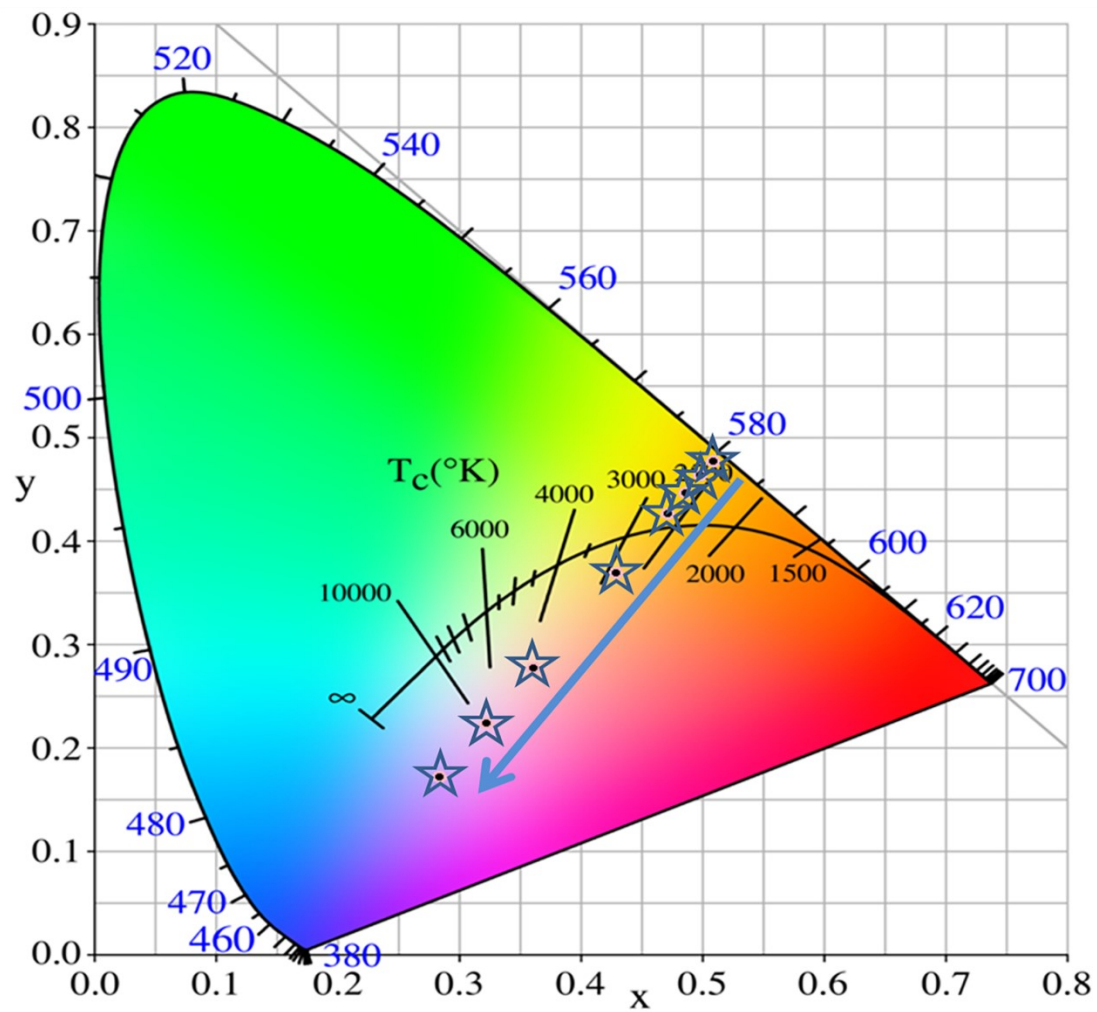


Figure S4. The CIE chromaticity diagram of the sample at different solid solution concentration.

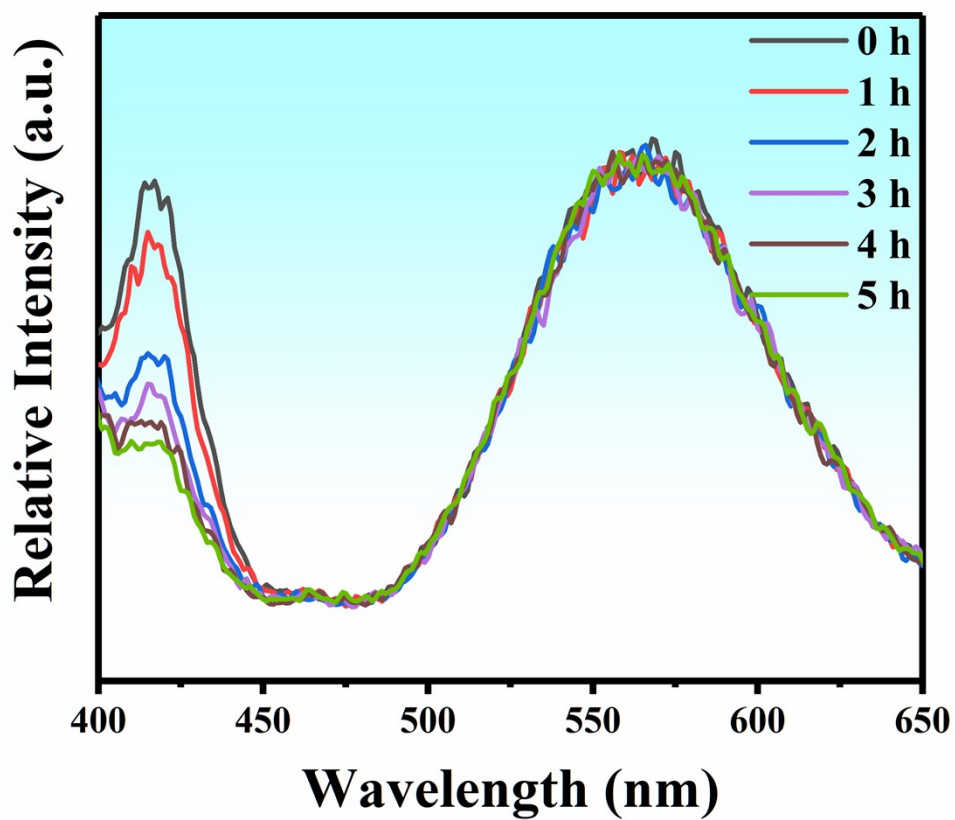


Figure S5. Spectra of sample under the excitation of a 340 nm UV on-chip LED for continuous working 5 h.

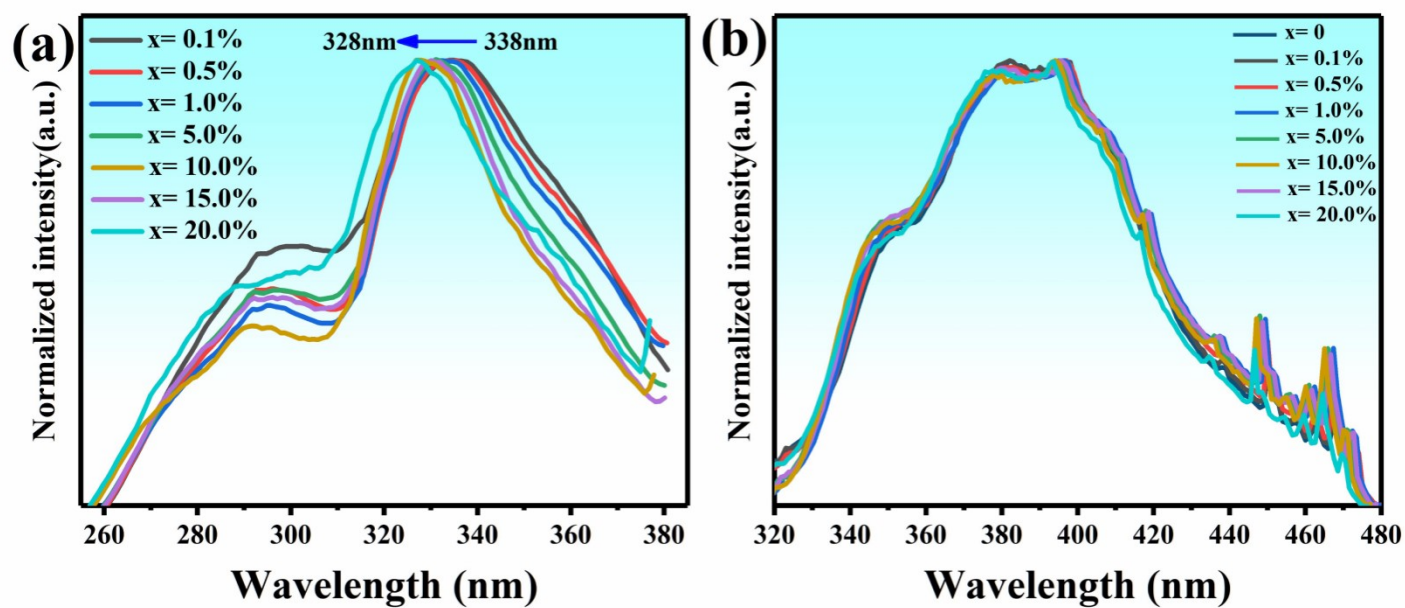


Figure S6. The normalized spectra of a) oxygen vacancies; b)Eu²⁺.

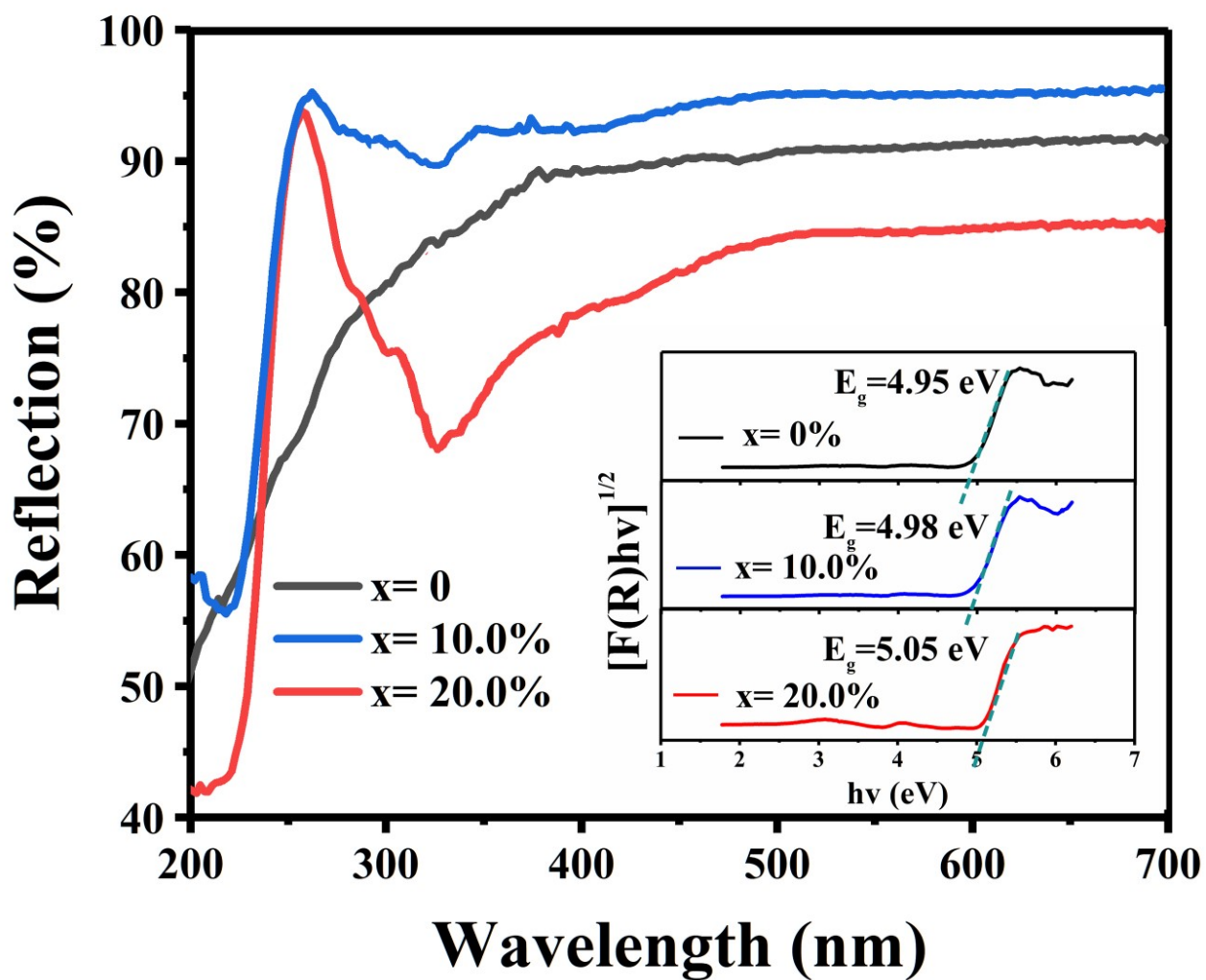


Figure S7. Diffuse reflection spectra of $\text{Ca}_{2-x}\text{Sr}_x\text{BO}_3\text{Cl}$ (The inset exhibits the estimated optical bandgap of $\text{Ca}_{2-x}\text{Sr}_x\text{BO}_3\text{Cl}$).

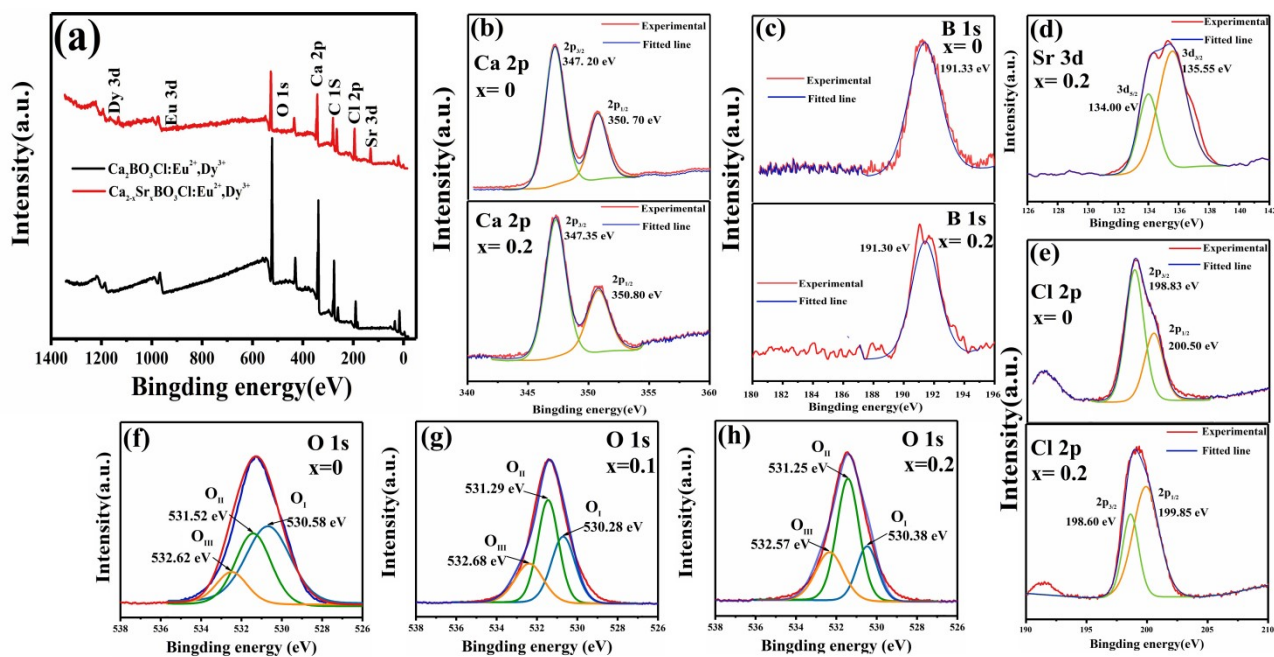


Figure S8. XPS survey spectra of $\text{Ca}_{2-x}\text{Sr}_x\text{BO}_3\text{Cl}:\text{Eu}^{2+}, \text{Dy}^{3+}$. b) Spectra at binding energies for Ca 2p; c) B 1s; d) Sr 3d; e) Cl 2p; f), g) and h) O 1s.

Table S1. The lattice parameters, volume, Refinement parameters of $\text{Ca}_{2-x}\text{Sr}_x\text{BO}_3\text{Cl}$ (x= 0, 10%, 20%).

| Sample | a(Å) | b(Å) | c(Å) | $\alpha=\gamma(^{\circ})$ | $\beta(^{\circ})$ | V(Å ³) | Z | R _{wp} | P _p | χ^2 |
|--------|--------|--------|---------|---------------------------|-------------------|--------------------|---|-----------------|----------------|----------|
| x= 0 | 3.9338 | 8.6515 | 12.3504 | 90 | 100.2708 | 413.58 | 4 | 12.08% | 9.99% | 1.538 |
| x= 10% | 3.9435 | 8.6720 | 12.3837 | 90 | 100.2785 | 416.70 | 4 | 11.46% | 8.47% | 1.496 |
| x= 20% | 3.9485 | 8.6865 | 12.4046 | 90 | 100.2841 | 418.63 | 4 | 11.08% | 8.35% | 1.487 |

