Visualizing electroluminescence process in light-emitting electrochemical cells.

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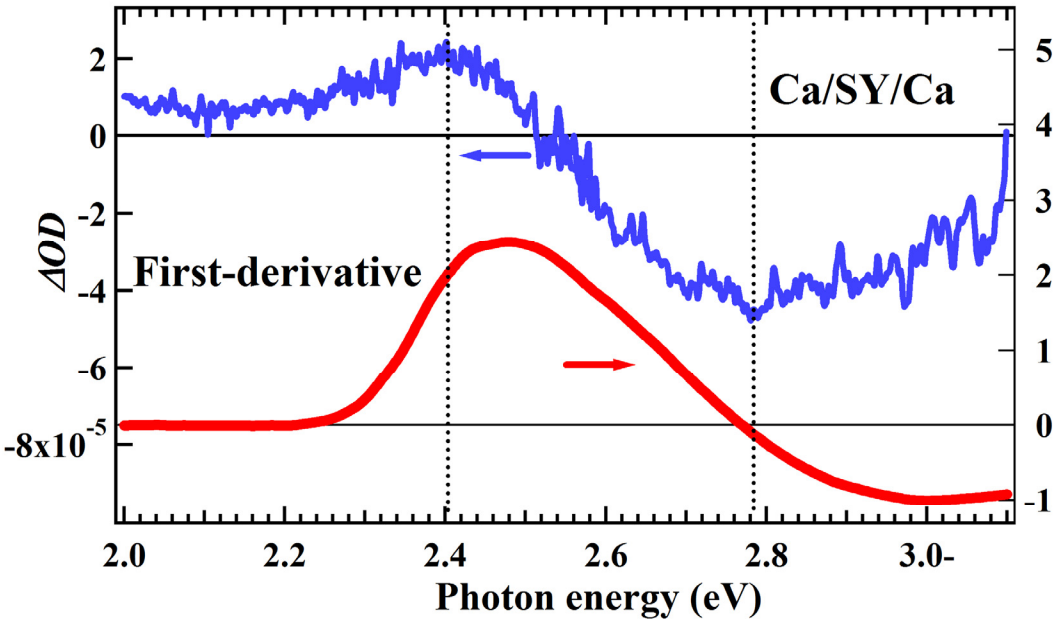
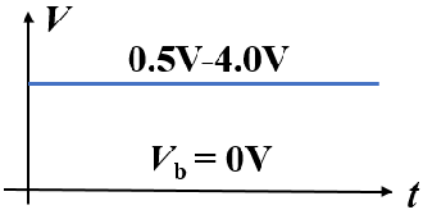
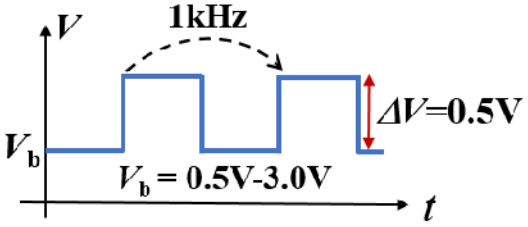


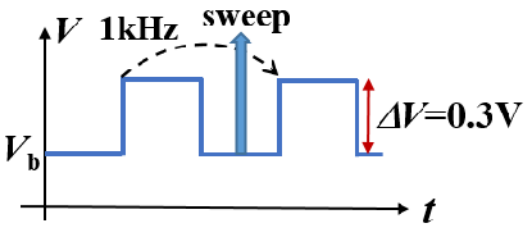
Figure S1 | Comparison of BM spectrum of electron-only diode and the first-derivative spectrum. This figure compares the bias-modulation (BM) spectrum of the electron-only device (Ca/Super yellow (SY)/Ca) with the first-derivative of the ground-state absorption spectrum of SY.

(a) Bias-induced (BI) spectroscopy: Fig. 2a

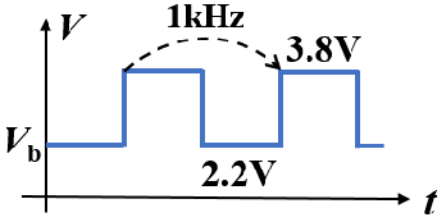


(b) Bias-modulation (BM) spectroscopy: Fig. 3a (left) and Fig. 3c (right)





(c) Time-resolved BM spectroscopy: Figs. 4a and b (left) and Fig. 4d (right)



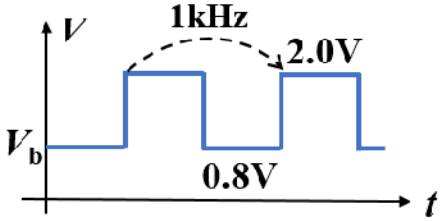


Figure S2 | Bias used for each spectroscopy: a Constant bias used for bias-induced (BI) measurements. **b** Square-wave AC bias (1kHz) used for bias-modulation (BM) measurements. **c** Square-wave AC bias (1kHz) used for time-resolved BM measurements.

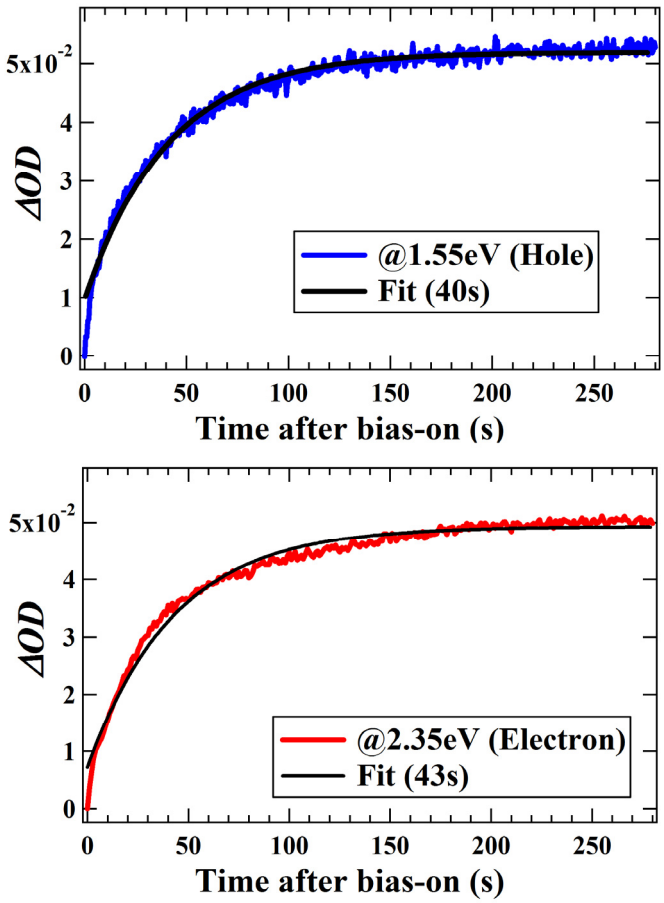


Figure S3 | Fit results for the signal increase process. The results of the signal increase process during the 3V-bias application shown in Fig. 2b were fitted with a single exponential curve. The best-fit results for the bias-induced signals at 1.55eV and 2.35eV were 40s and 43s respectively.

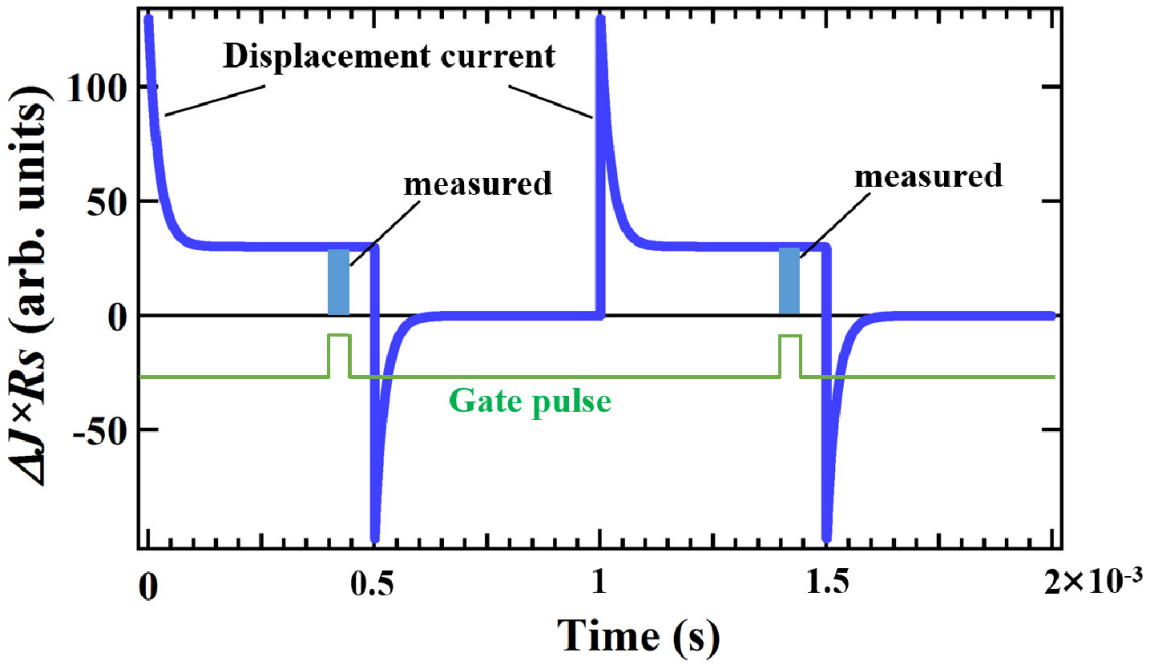


Figure S4 | Explanation of the current measurement in the modulation experiments. Applying a squared AC bias to an LEC, an obtained current including a displacement current that occurs at the moments of bias-on and off and decays depending on a circuit constant. In order to remove the contribution of the displacement current, the current under the application of squared bias was measured after reaching a steady-state value where the displacement current is negligibly small, using the gate function of the boxcar integrator.

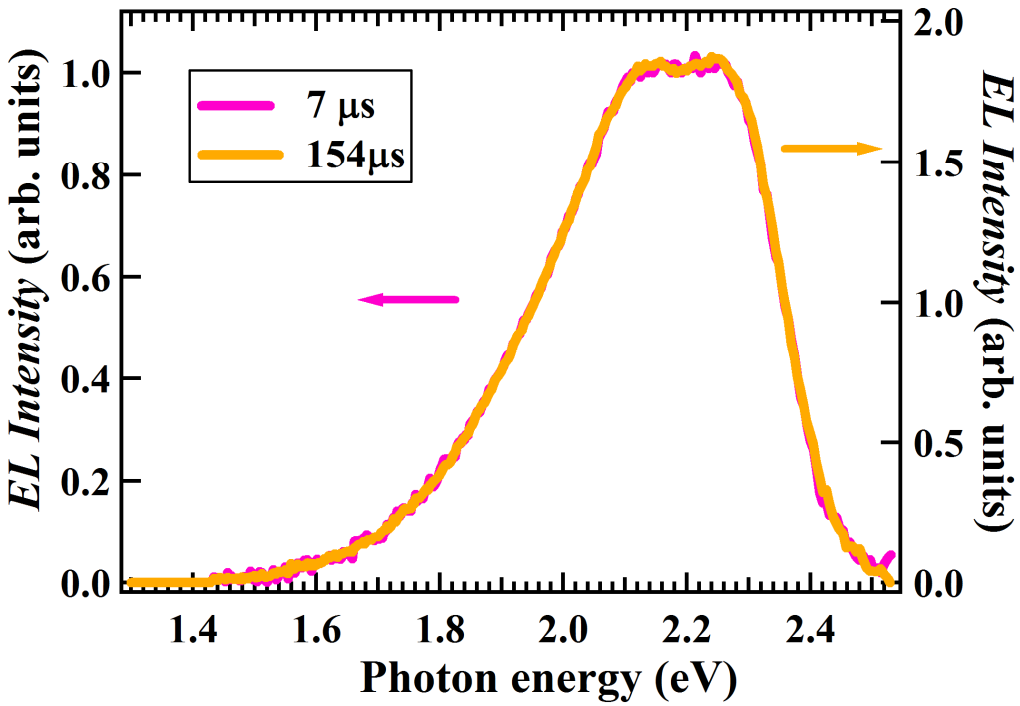


Figure S5 | Comparison of time-resolved EL spectra. This figure compares the time-resolved EL spectra in Figure 4c obtained at 7 and 154 μs after the increase of bias from 2.2 V to 3.8 V and indicates the two spectra coincide with each other.

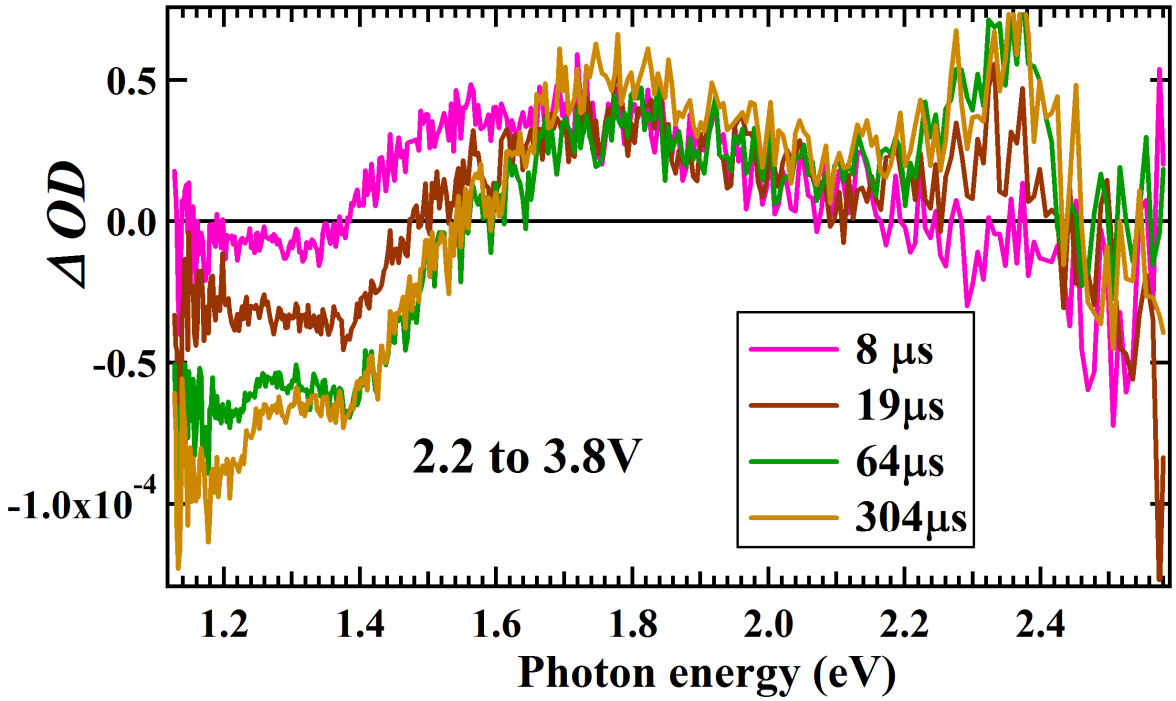


Figure S6 | Time-resolved BM spectra. Time-resolved BM spectra of the SY-LEC for the bias raised from 2.2 V to 3.8 V obtained from the device different from the one shown in the main text.

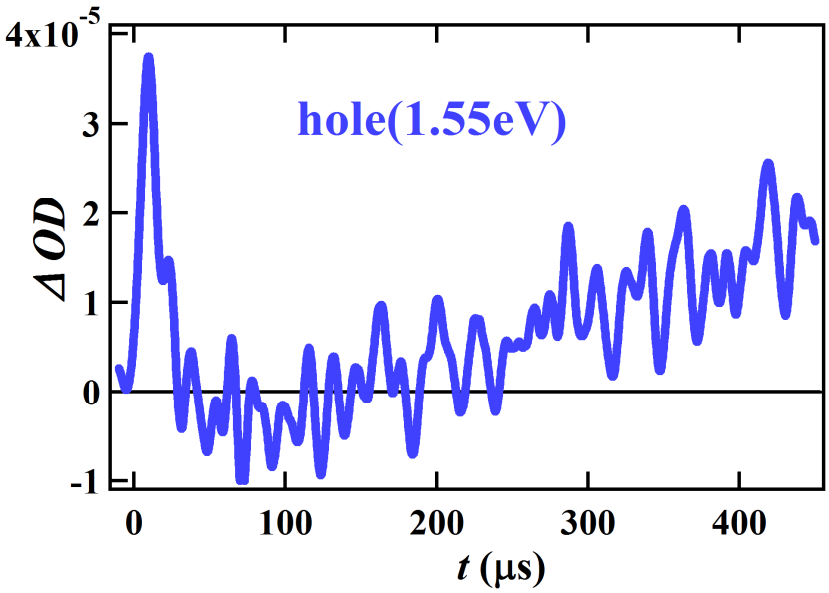


Figure S7 | Enlarged view of the transient response of hole signal. Enlarged view of the transient response of the BM signal measured at 1.55 eV for the hole carriers shown in Fig. 4e.