CaF$_2$: Eu Films Shine Novel Blue, White or Red luminescence though Adjustment of Valence state of Eu Ions using Electro-deposition Method

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Scheme S1. Schematic illustration for the formation of Eu$^{2+}$/Eu$^{3+}$ ions in preparation of CaF$_2$: Eu film.

Figure S1. Emission spectra from the CaF2: Eu thin films.

Figure S2 Time evolution of blue (425 nm) (under pulsed 372 nm excitation from 372 nanosecond laser) from a thin film of the CaF$_2$: 5% Eu, prepared at pH=3.5.
**Figure S3.** Time evolution of the red (613nm) emission under pulsed 254 nm excitation, from a thin film of the CaF$_2$: 5% Eu, prepared at pH=8.5

**Figure S4.** Emission spectra of the CaF$_2$: Eu films prepared at (a) pH=4.5, (b) pH=4.7, (c) pH=5.0.