

Supplementary

Table S1: Overview of number of MP-cycles, thickness (from ellipsometry), deposition rate, relative concentrations of each cation (from XRF), and surface roughness, R_q (from AFM for the as deposited thin films). NM means that no measurement data is available for that sample.

Pulse % EPO (%)	MP - cycles	Thickness (nm)	Deposition rate (Å/MP-cycle)	Eu % (cation %)	Ti % (cation %)	P % (cation %)	R_q (nm)
0	1000	82	0.82	0	46.0	54.0	NM
1	1400	113	0.81	NM	NM	NM	NM
5	1160	92	0.79	2.1	44.2	53.7	0.35
10	1150	97	0.84	3.0	41.7	55.3	0.30
20	1125	93	0.83	5.9	38.7	55.5	0.35
30	1220	104	0.86	8.8	34.3	56.9	0.31
40	1100	95	0.86	11.3	30.8	57.9	0.30
50	1080	100	0.92	13.9	27.0	59.1	0.37
60	1065	89	0.84	18.7	22.3	59.0	0.24
70	1100	97	0.88	23.7	17.4	58.9	0.25
80	1125	96	0.86	27.3	11.8	60.9	0.35
90	1060	97	0.92	32.4	6.5	61.1	0.33
100	1000	101	1.01	37.9	0	62.1	NM

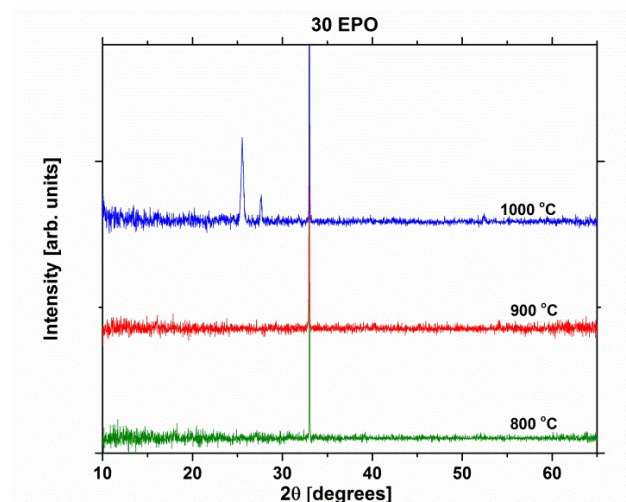


Figure S1: XRD 30 EPO 800-1000 °C. No crystalline phase could be detected after annealing below 900 °C.

Table S2: Surface Roughness, R_q , in nm from AFM scans shown in Figure S2 and Figure S3.

Annealing Temperature (°C)	20 EPO	30 EPO	70 EPO	80 EPO
600	0.3	0.2	-	-
700	2.0	2.9	0.1	0.1
800	11.3	2.0	1.0	1.1
1000	11.3	9.8	7.4	6.1

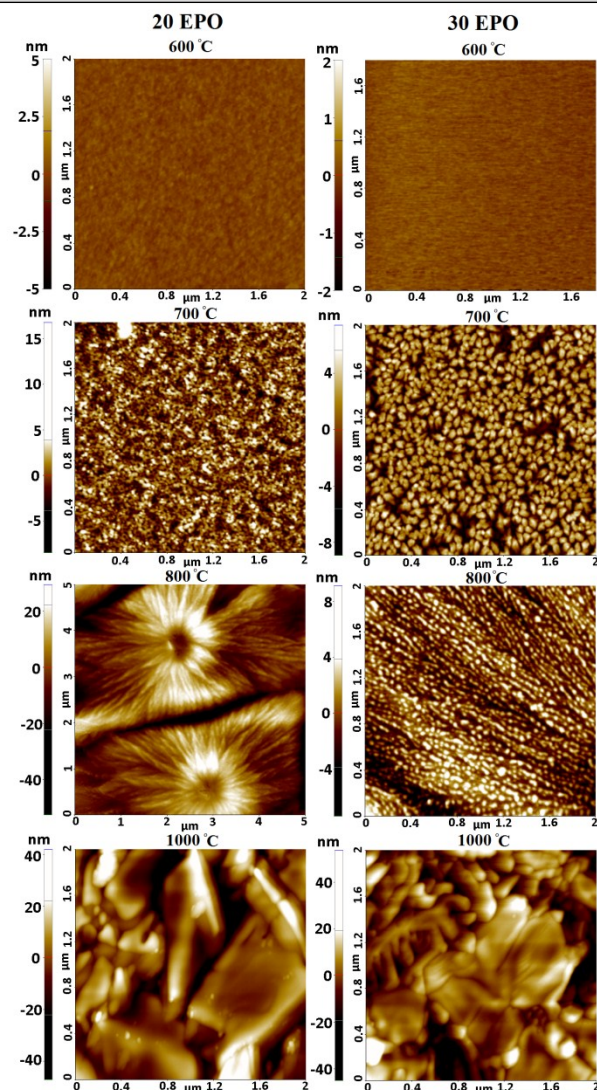


Figure S2: AFM images of samples with 20 EPO (left column) and 30 EPO (right column), annealed at 600, 700, 800 and 1000 °C. 20 and 30 EPO samples annealed at 600 °C or below did not exhibit any features. 20 EPO at 800 °C shows a larger scan area in order to better display the morphology of the sample. Note the difference in the z-scale.

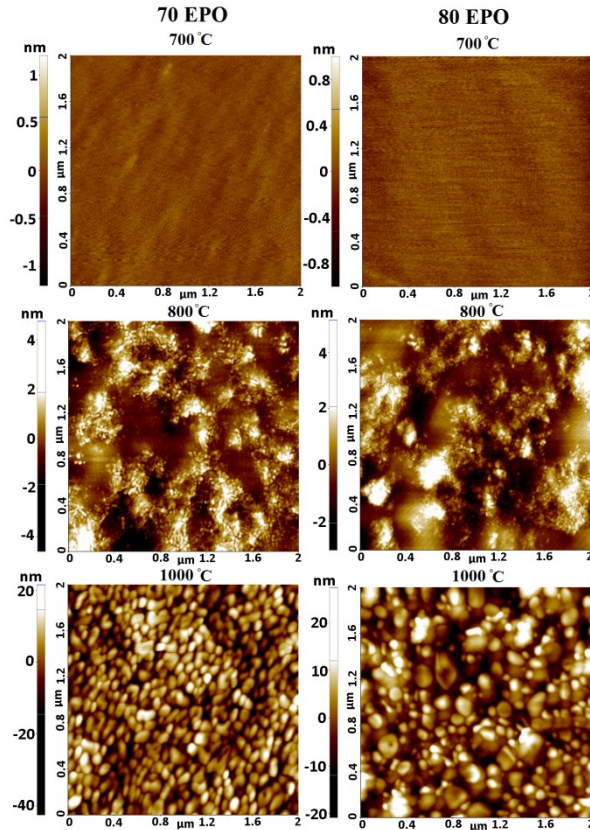


Figure S3: AFM images of samples with 70 EPO (left column) and 80 EPO (right column), annealed at 700, 800 and 1000 °C. 70 and 80 EPO samples annealed at 700 °C or below did not exhibit any features. Note the difference in the z-scale.

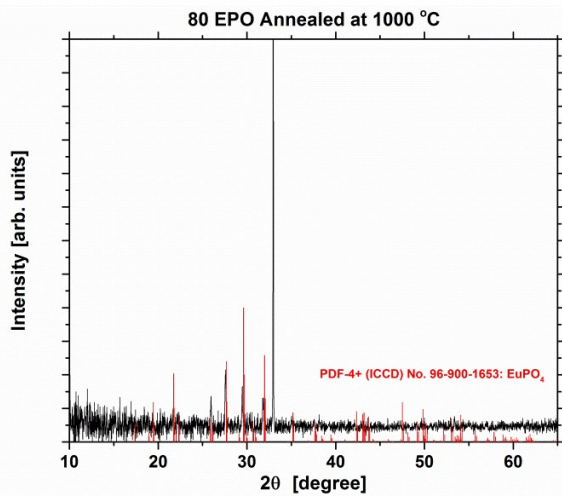


Figure S4: XRD of 80 EPO compared with EuPO₄ crystal data.

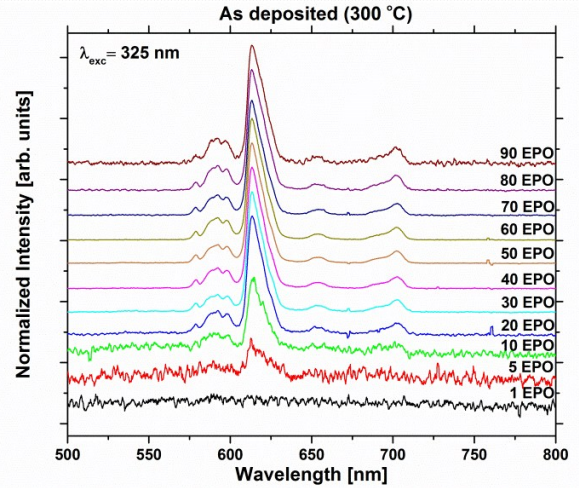


Figure S5: Normalized PL emission spectra of as deposited samples with increasing pulse % EPO from bottom to top. 1-10 EPO are quenched due to photobleaching.

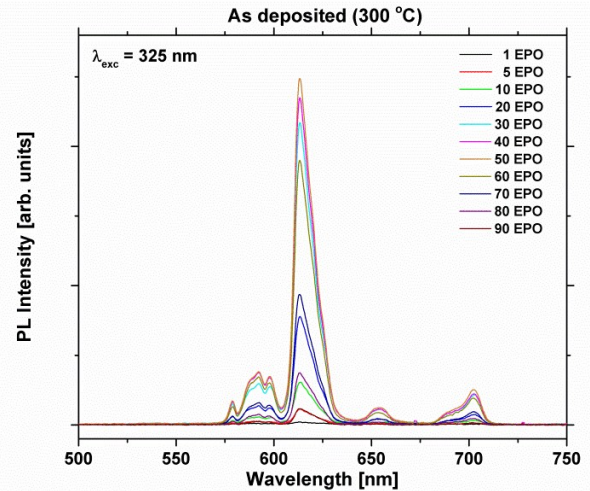


Figure S6: PL of as deposited samples after 20 s of laser exposure. Shape of emission is identical for all compositions.

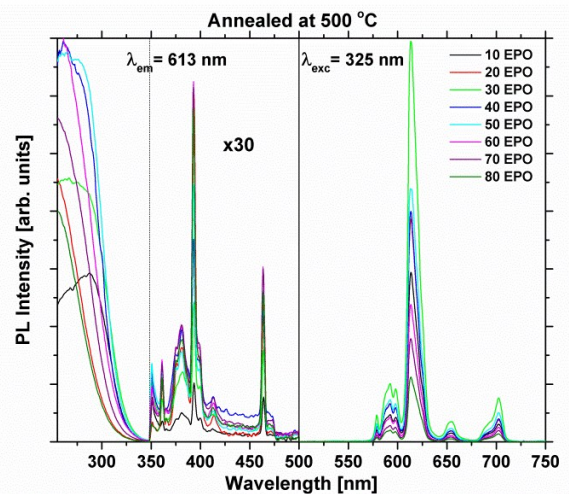


Figure S7: Excitation measurements of 10-80 pulse % EPO of samples annealed at 500 °C, monitoring the Eu³⁺ emission at 613 nm (left). PL emission from 325 nm laser (right). PLE and PL were not measured with the same equipment.

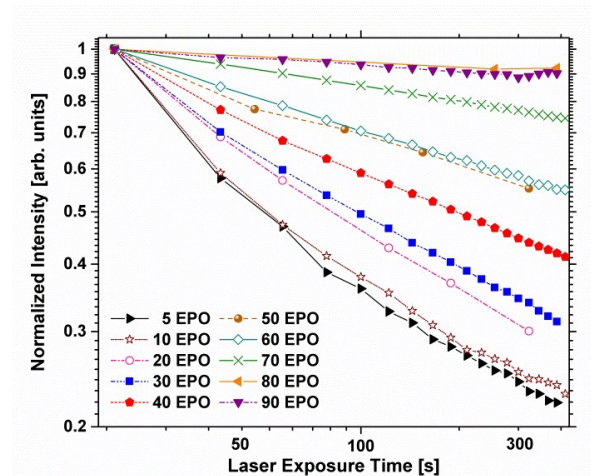


Figure S8: Normalized PL intensity vs. laser exposure time for as deposited samples plotted on logarithmic scales.

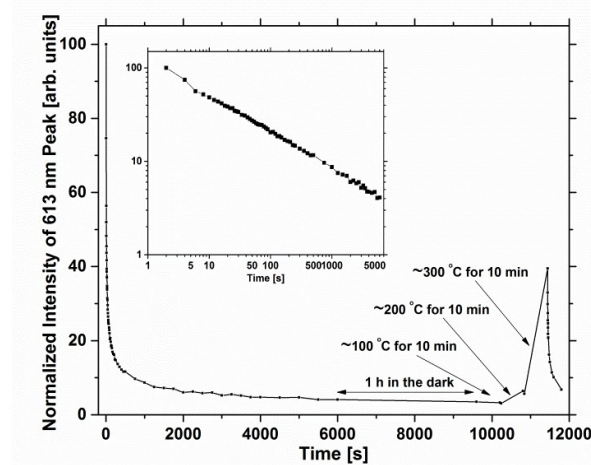


Figure S9: Normalized luminescence intensity of the Eu³⁺ emission at 613 nm for an as deposited sample containing 20 EPO vs. laser exposure time. After 6000 s the sample was left in the dark for 1 h before being heated on a hot plate for 10 min at 100, 200 and 300 °C. The luminescence was completely recovered after tempering in a furnace at 300°C for 1 h. Inset shows the first 6000 s of the experiment on logarithmic scales.

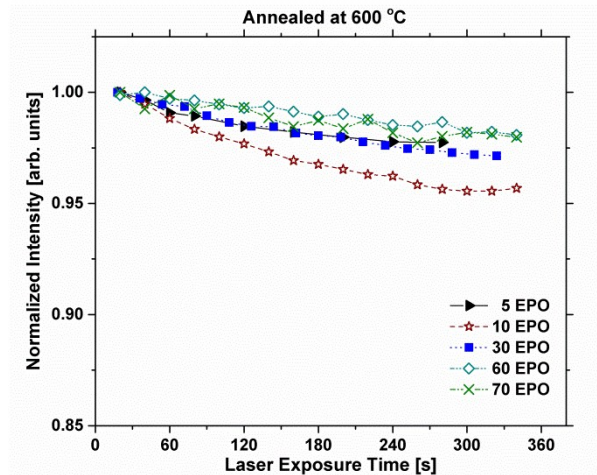


Figure S10: Normalized PL intensity vs. laser exposure time for selected samples annealed at 600 °C, plotted on a linear scale.

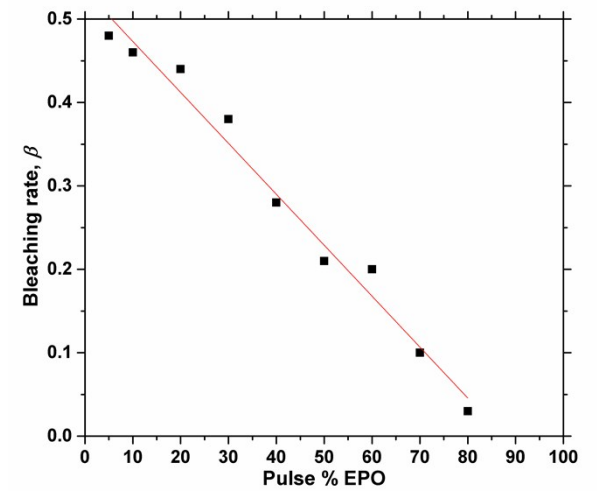


Figure S11: Bleaching rate for as deposited samples exposed to 325 nm excitation, fitted to a linear curve. 1 and 90 EPO were omitted due to low signal to noise ratio for these samples.

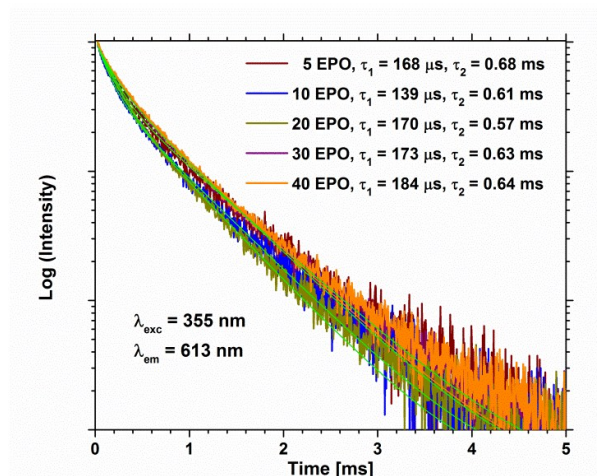


Figure S12: PL decay measurements of as deposited samples with 5-40 EPO, fitted by a biexponential decay function.

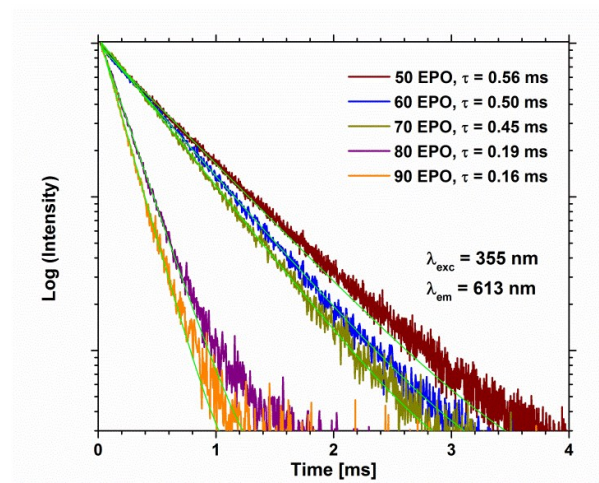


Figure S13: PL decay measurements of as deposited samples with 50-90 EPO, fitted by a single exponential decay function.

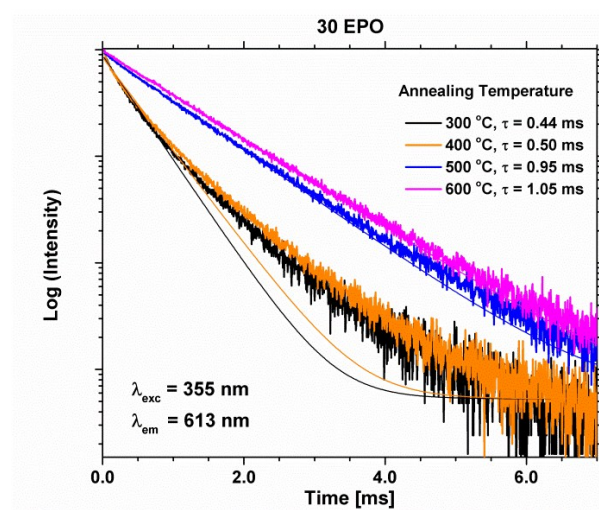


Figure S14: PL decay measurements of samples with 30 EPO and annealed at 300-600 °C. τ is extracted from fitting the data to a single exponential decay function.

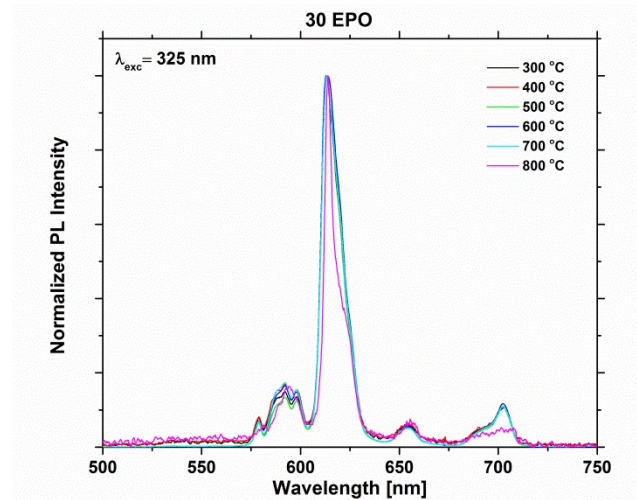


Figure S15: Normalized PL of samples containing 30 EPO and annealed at 300-800 °C. The shape of the spectrum remains unchanged up to 800 °C.

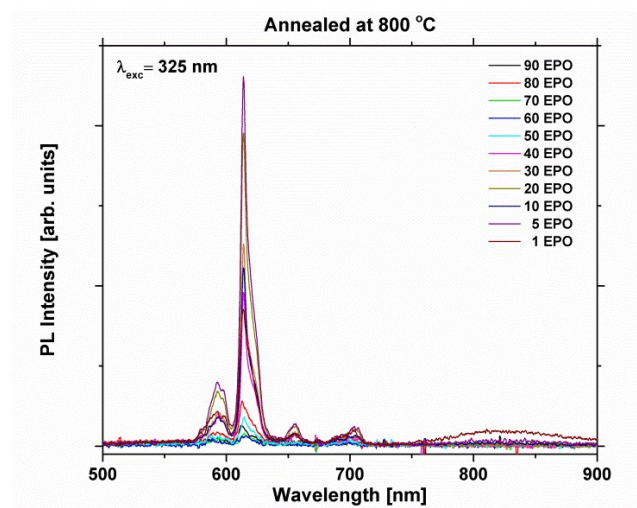


Figure S16: PL of samples annealed at 800 °C.

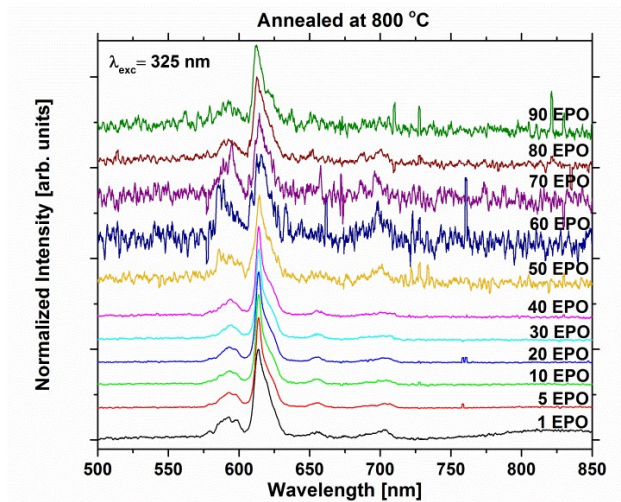


Figure S17: Normalized PL scans of samples annealed at 800 °C.

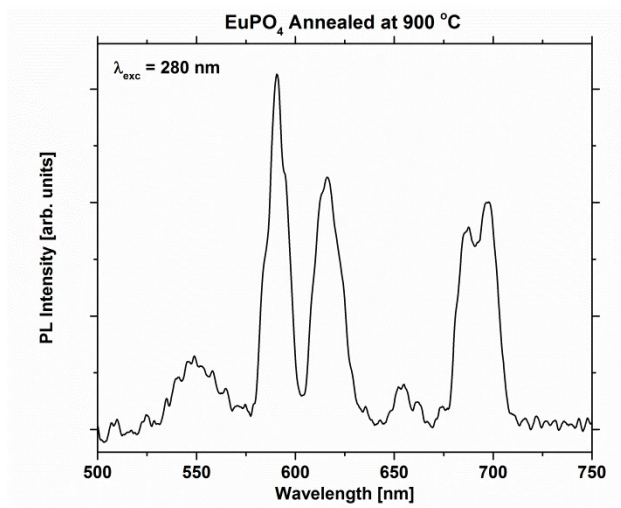


Figure S18: PL emission of 100 EPO annealed at 900 °C.