New Journal of Chemistry

ELECTRONIC SUPPLEMENTARY INFORMATION

Effect of Eu^{3+} and Gd^{3+} co-doping on morphology and luminescence of $NaYF_4$: Eu^{3+}, Gd^{3+} phosphors

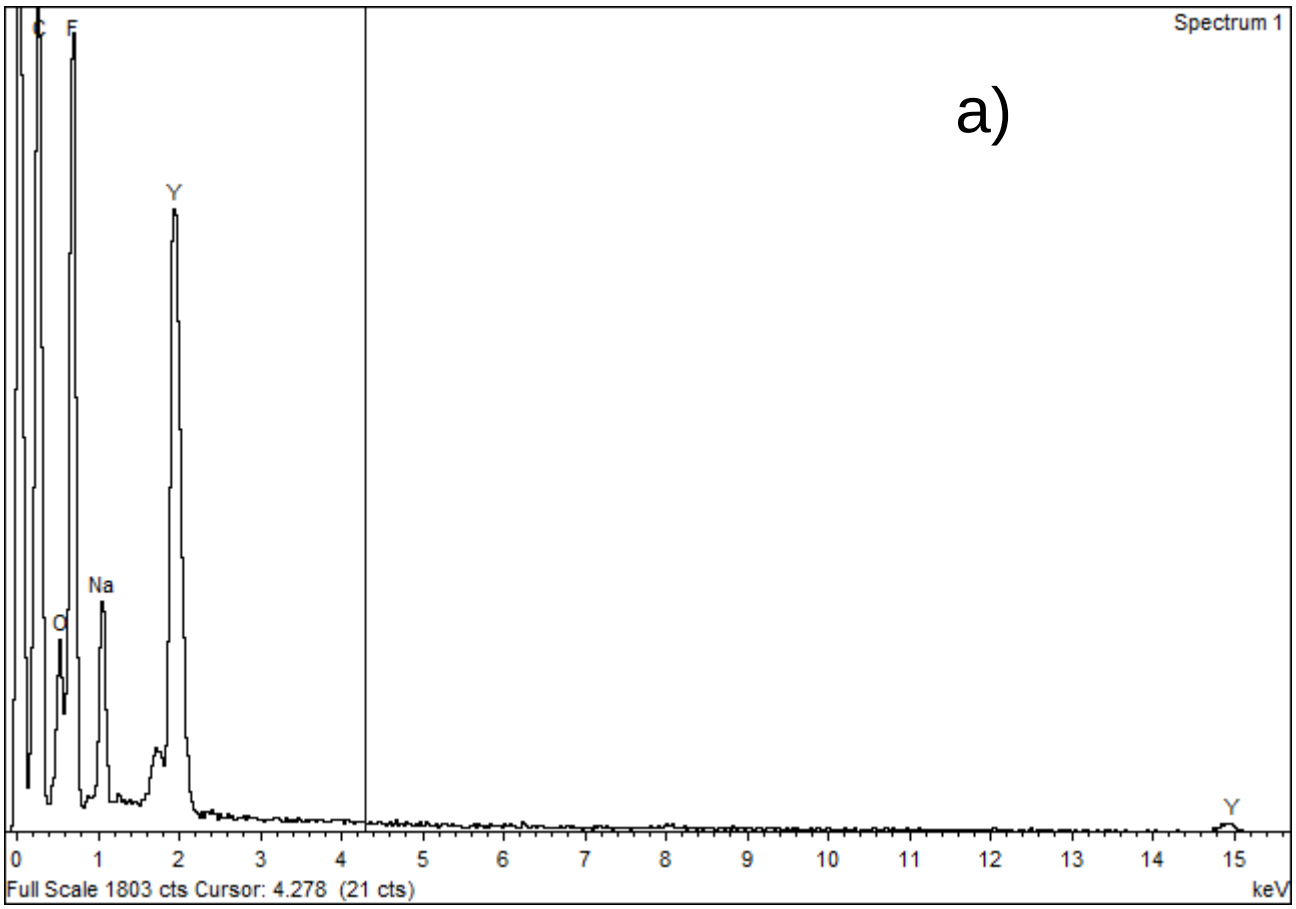
Ilya E. Kolesnikov, [a,b,*] *Aleksandra A. Vidyakina,* [a] *Marina S. Vasileva,* [a] *Viktor G. Nosov,*[a] *Nikita A. Bogachev,*[a,c] *Vladimir B. Sosnovsky,*[c] *Mikhail Y. Skripkin,*[a,c] *Ilya I. Tumkin,* [a] *Erkki Lähderanta* [b]*, and Andrey S. Mereshchenko* [a,c,*]

[a] Saint-Petersburg State University, 7/9 Universitetskaya emb., St. Petersburg 199034, Russia;

[b] LUT University, Skinnarilankatu 34, 53850 Lappeenranta, Finland;

[c] Sirius University of Science and Technology, 1 Olympic Ave, Sochi 354340, Russia.

The supplementary materials contain EDX spectra of synthesized samples and the content of rare earth elements in the samples extracted from EDX spectra.


Spectrum 1
a)
C
F
Y
Na
O
Y
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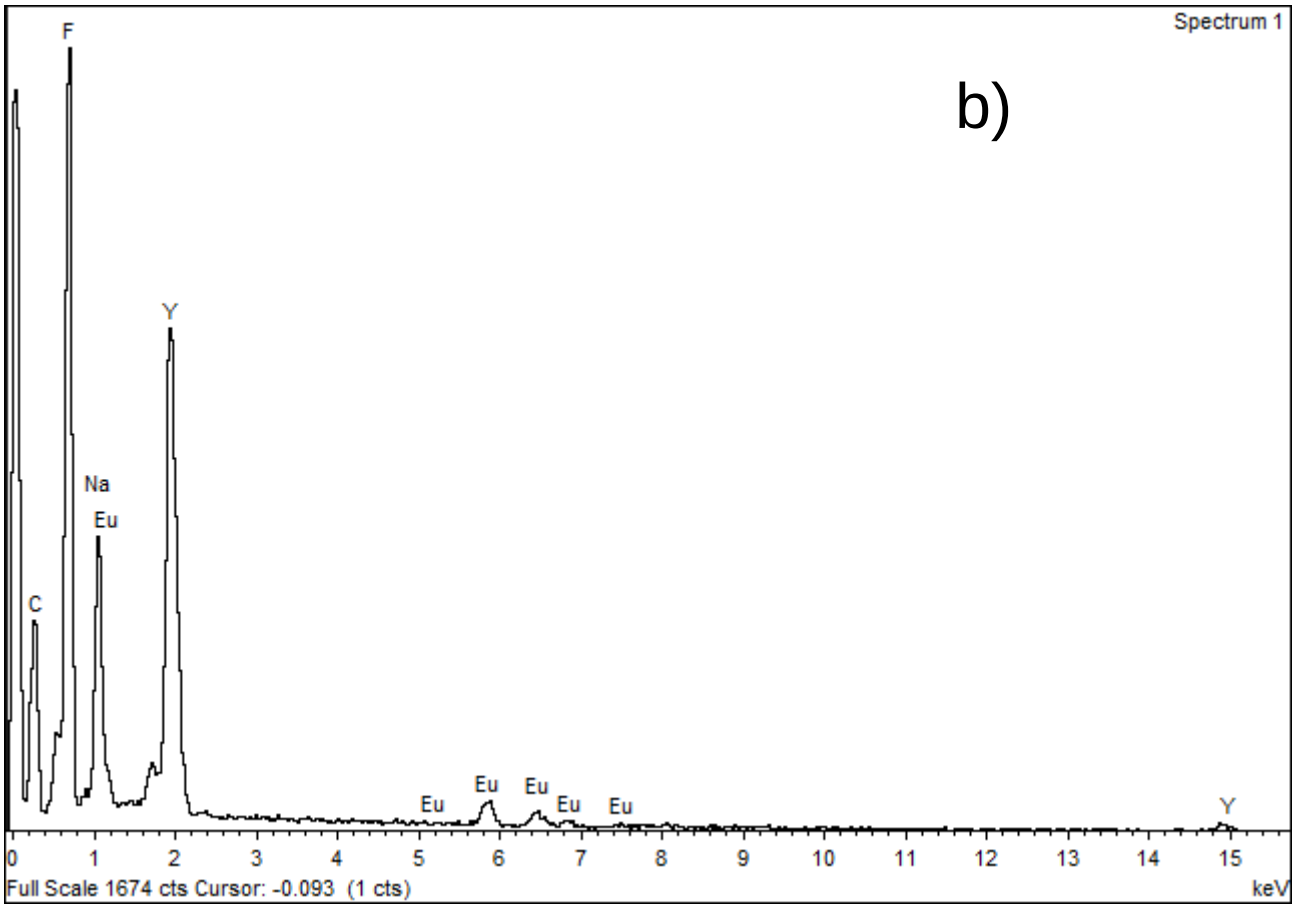
keV


Spectrum 1
b)
F
Y
Na
Eu
C
Eu
Eu
Eu
Eu
Eu
Y
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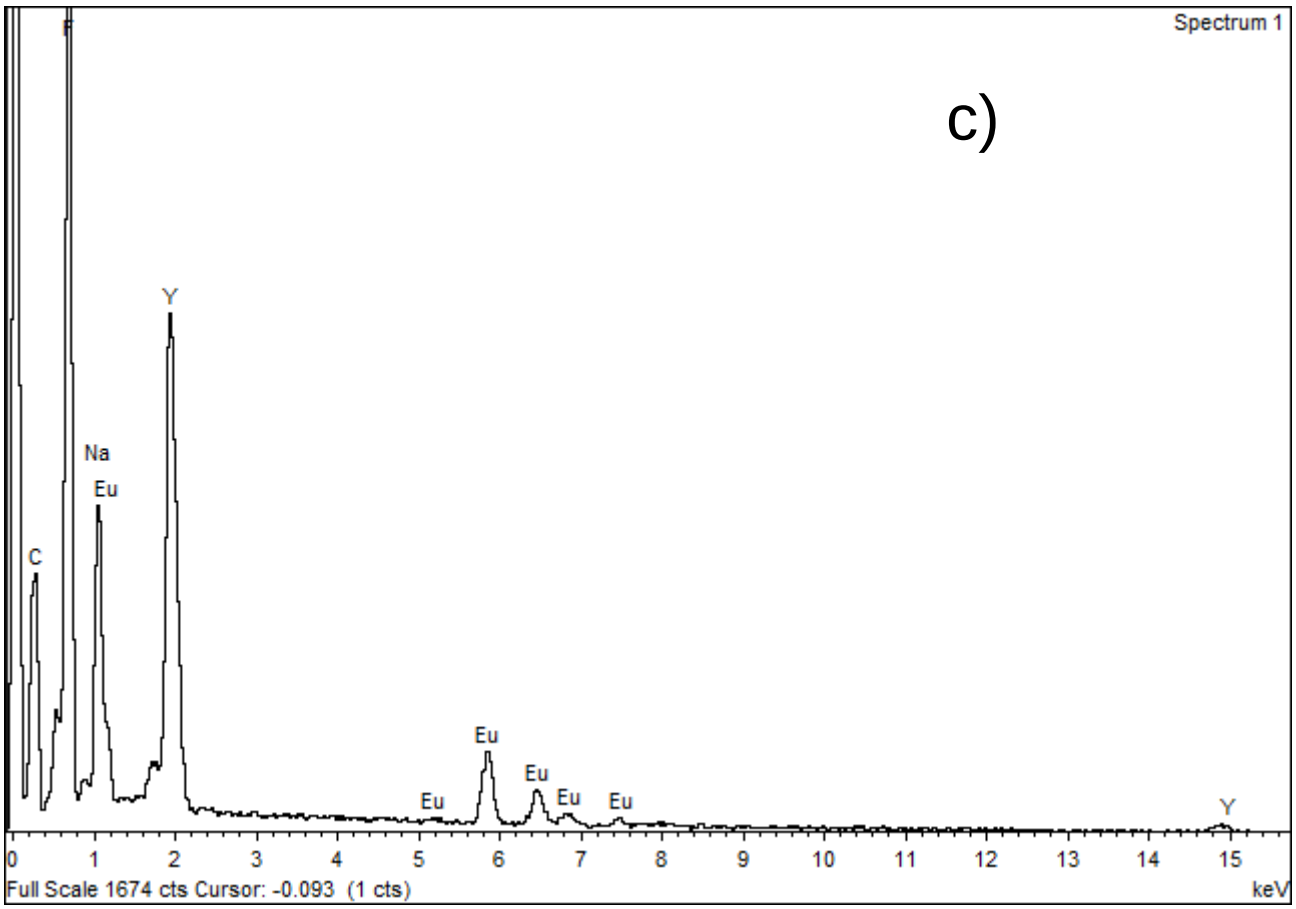
Full Scale 1674 cts Cursor: -0.093 (1 cts)
keV


Spectrum 1
c)
F
Y
Na
Eu
C
Eu
Eu
Eu
Eu
Eu
Y
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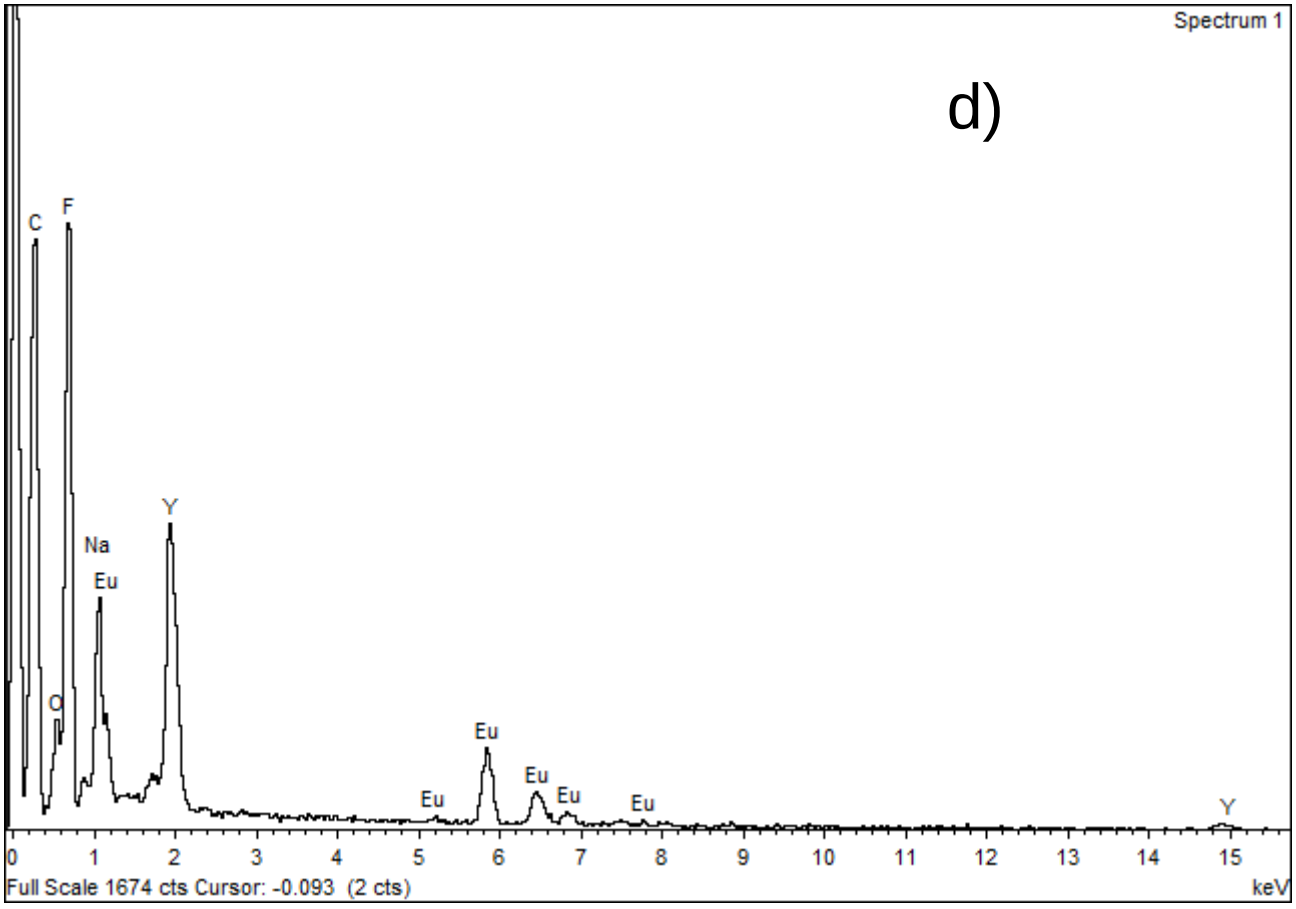
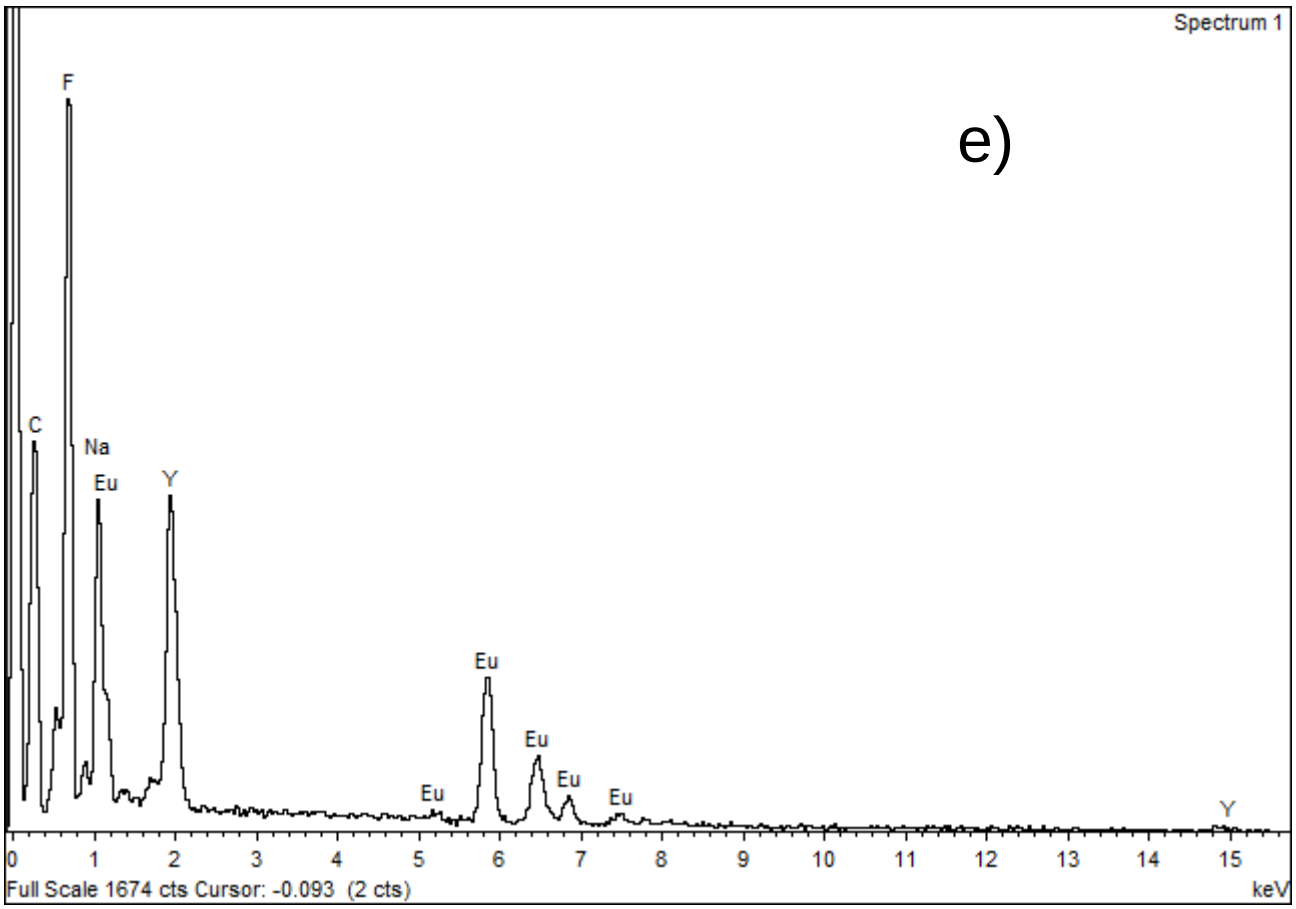
Full Scale 1674 cts Cursor: -0.093 (1 cts)
keV


Spectrum 1
d)
C
F
Y
Na
Eu
O
Eu
Eu
Eu
Eu
Eu
Y
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Full Scale 1674 cts Cursor: -0.093 (2 cts)
keV


Spectrum 1
e)
F
C
Na
Eu
Y
Eu
Eu
Eu
Eu
Eu
Y
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
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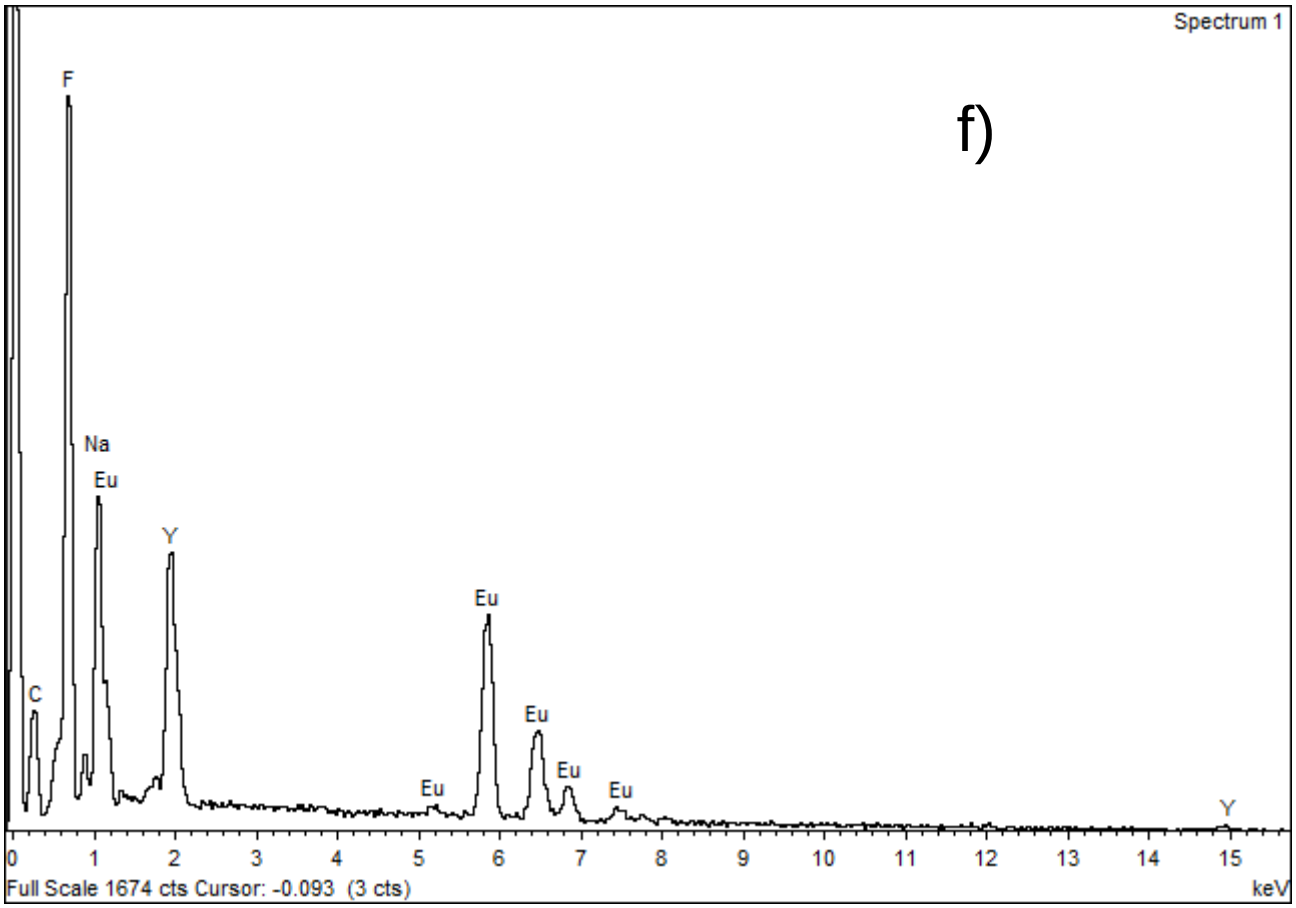
keV


Spectrum 1
f)
F
Na
Eu
Y
C
Eu
Eu
Eu
Eu
Eu
Y
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
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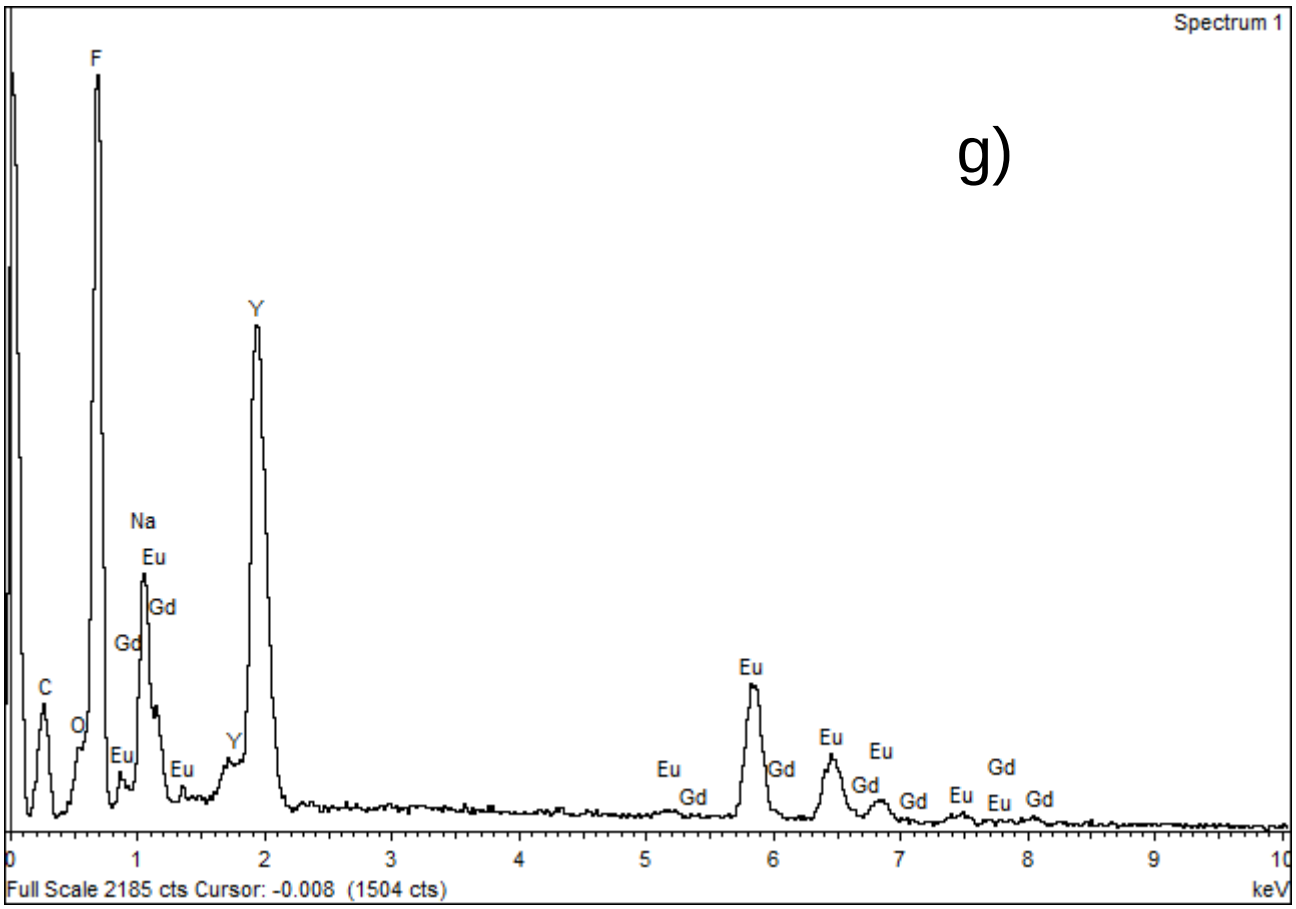
keV


Spectrum 1
g)
F
C
O
Na
Eu
Gd
Y
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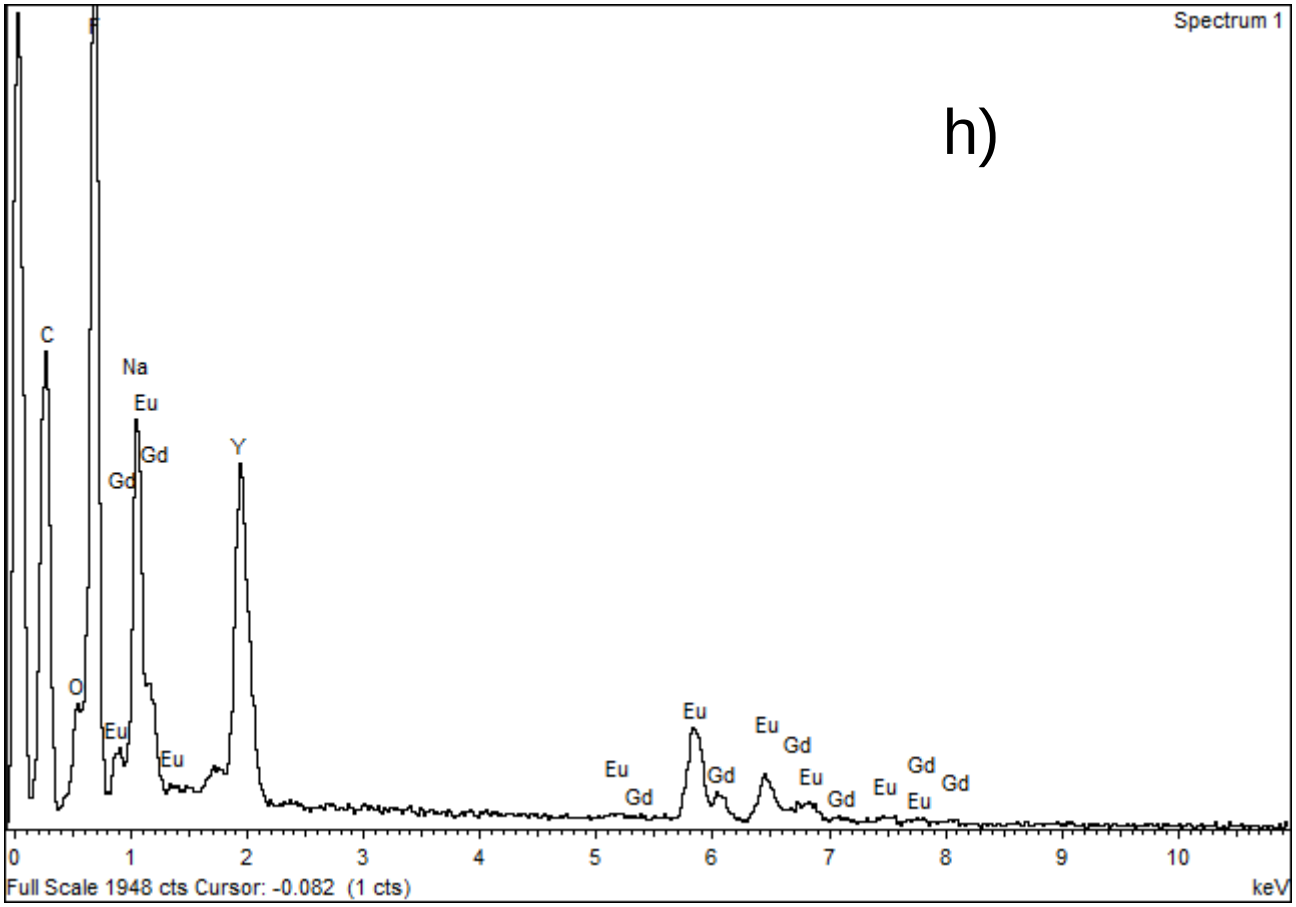
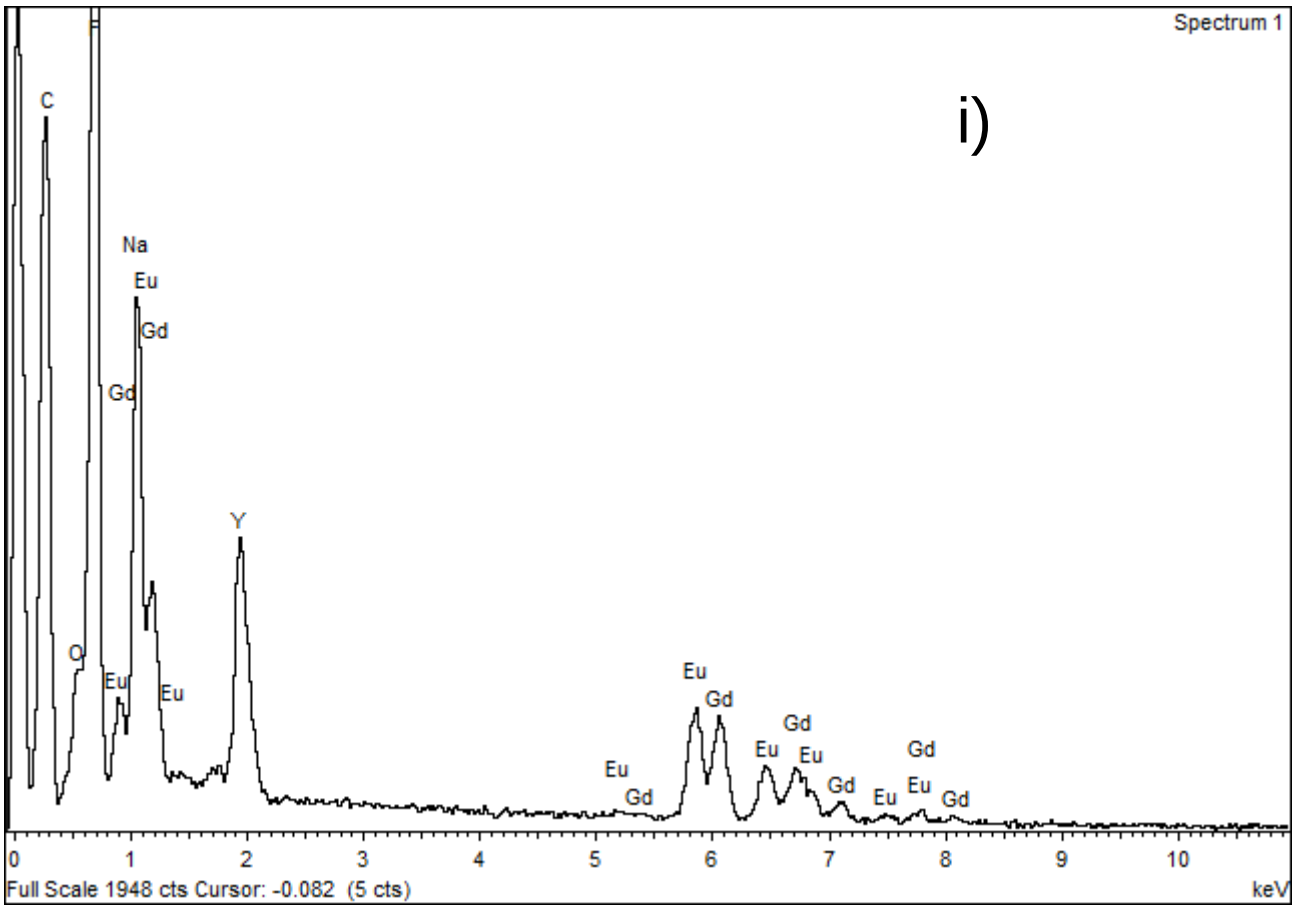
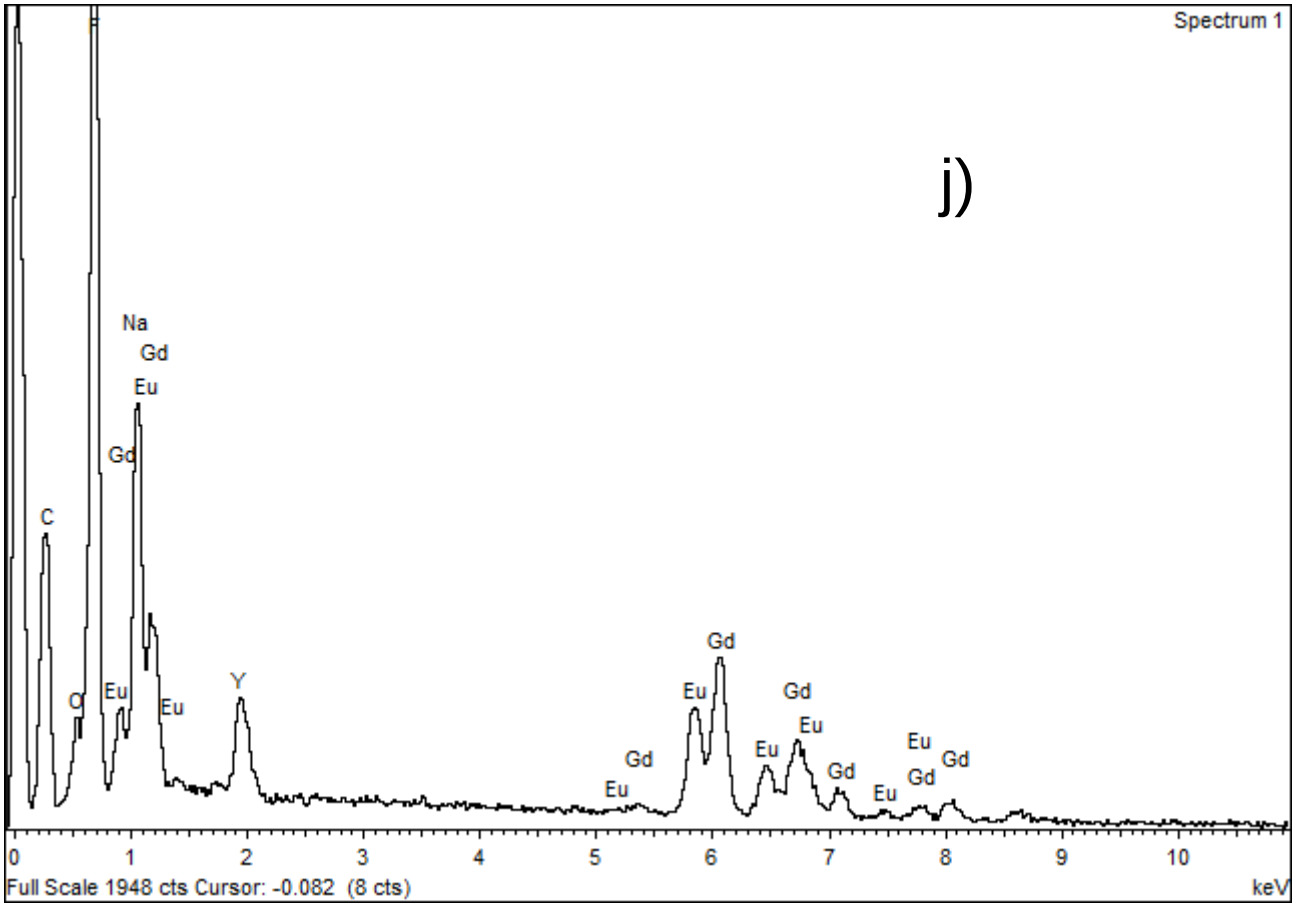
keV


Spectrum 1
h)
C
O
Na
Eu
Gd
Y
Full Scale 1948 cts Cursor: -0.082 (1 cts)
keV


Spectrum 1
i)
C
F
Na
Eu
Gd
Gd
Y
O
Eu
Eu
Eu
Gd
Eu
Gd
Eu
Gd
Eu
Gd
Eu
Gd
Eu
Gd
0 1 2 3 4 5 6 7 8 9 10
Full Scale 1948 cts Cursor: -0.082 (5 cts)
keV


Spectrum 1
j)
C
F
Na
Gd
Eu
Gd
Y
O
Eu
Eu
Eu
Gd
Gd
Eu
Gd
Eu
Eu
Gd
Eu
Gd
Eu
Gd
0 1 2 3 4 5 6 7 8 9 10
Full Scale 1948 cts Cursor: -0.082 (8 cts)
keV

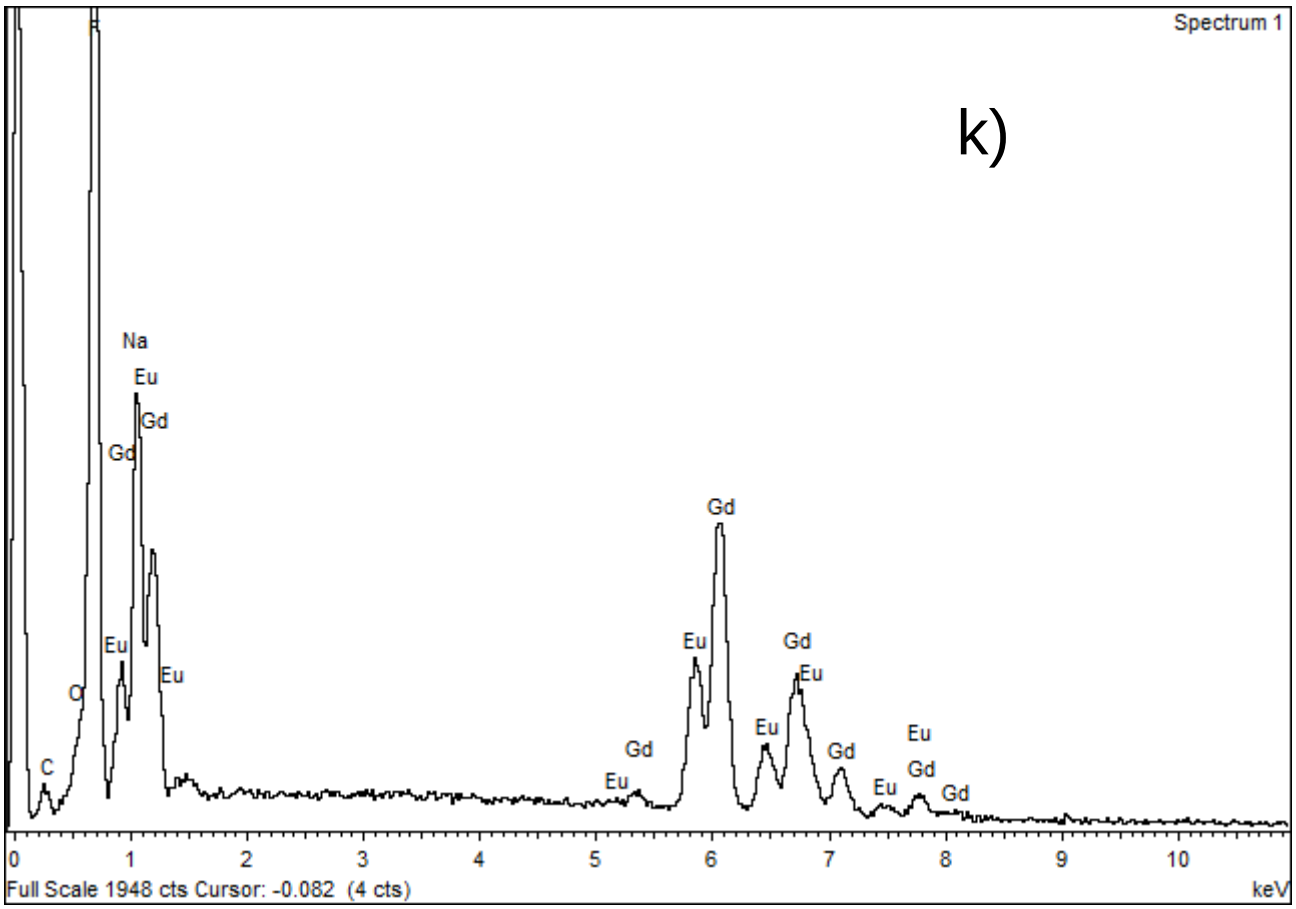


Fig. S1. EDX spectra of the samples: a) $NaYF_4$: 0% Eu, b) $NaYF_4$: 10% Eu, c) $NaYF_4$: 20% Eu, d) $NaYF_4$: 30% Eu, e) $NaYF_4$: 40% Eu, f) $NaYF_4$: 50% Eu, g) $NaYF_4$: 30% Eu, 1% Gd, h) $NaYF_4$: 30% Eu, 10% Gd, i) $NaYF_4$: 30% Eu, 30% Gd, j) $NaYF_4$: 30% Eu, 50% Gd, k) $NaYF_4$: 30% Eu, 70% Gd.

Table S1. The content of rare earth elements in the samples extracted from EDX spectra. The concentration of elements is shown relative to the total amount of rear earth elements.

Sample	**C(Y^{3+}), at. %**	**C(Eu^{3+}), at. %**	**C(Gd^{3+}), at. %**
$NaYF_4$	100	0	0
$NaYF_4$: 10% Eu	91±2%	9±2%	0
$NaYF_4$: 20% Eu	81±2%	19±2%	0
$NaYF_4$: 30% Eu	73±3%	27±3%	0
$NaYF_4$: 40% Eu	62±3%	38±3%	0
$NaYF_4$: 50% Eu	51±3%	49±3%	0
$NaYF_4$: 30% Eu, 1% Gd	67±3%	31±3%	2±1
$NaYF_4$: 30% Eu, 10% Gd	63±3%	27±3%	10±2%
$NaYF_4$: 30% Eu, 30% Gd	42±3%	28±5%	30±5%
$NaYF_4$: 30% Eu, 50%	24±3%	27±3%	49±3%
$NaYF_4$: 30% Eu, 70% Gd	0	28±3%	72±3%

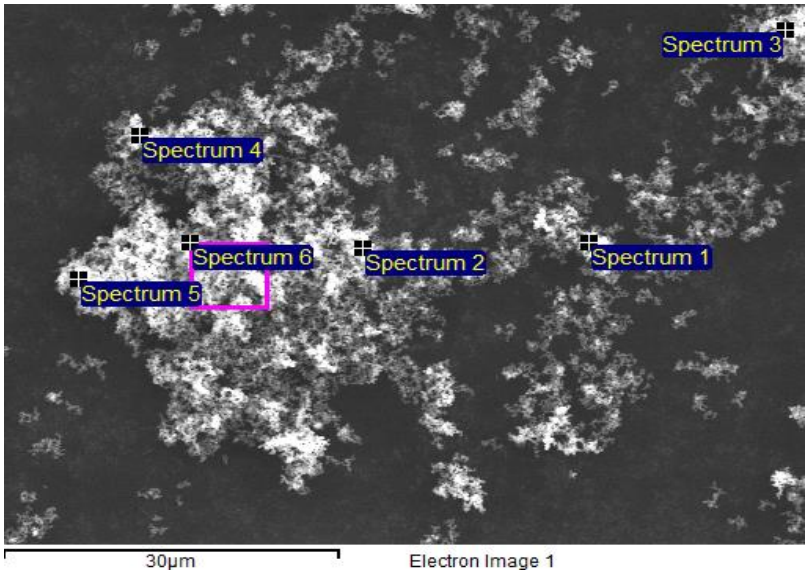


Fig. S2. SEM images of $NaYF_4$: Eu^{3+} 30% sample. The EDX spectra were measure at the several points marked as Spectrum 1 – 6.

Table S2. The distribution of elements among the $NaYF_4$: Eu^{3+} 30% sample (Fig. S2) obtained from EDX spectra.

Sample	**C(Na), at. %**	**C(Y), at. %**	**C(Eu), at. %**	**C(F), at. %**
Spectrum 1	10.8	6.8	2.6	79.8
Spectrum 2	12.7	7.1	2.6	77.5
Spectrum 3	11.6	6.3	2.3	79.8
Spectrum 4	10.7	6.0	2.2	81.1
Spectrum 5	11.4	7.2	2.8	78.5
Spectrum 6	14.0	7.0	2.7	76.3
Mean	11.9	6.8	2.5	78.8
St. dev.	1.3	0.5	0.2	1.8

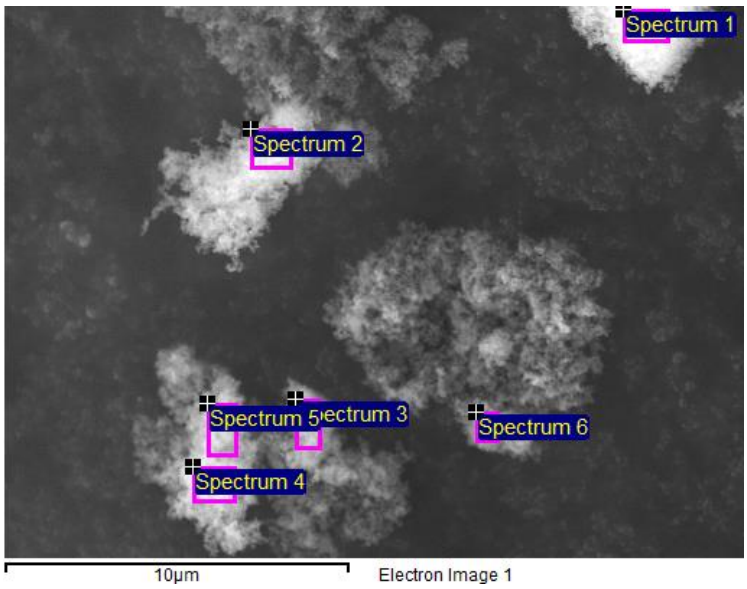


Fig. S3. SEM images $NaYF_4$:Eu^{3+} 30%, Gd^{3+} 30% sample. The EDX spectra were measure at the several points marked as Spectrum 1 – 6.

Table S3. The distribution of elements among the $NaYF_4$: Eu^{3+} 30%, Gd^{3+} 30% sample (Fig. S3) obtained from EDX spectra.

Sample	**C(Na), at. %**	**C(Y), at. %**	**C(Eu), at. %**	**C(Gd), at. %**	**C(F), at. %**
Spectrum 1	14.4	4.1	2.3	2.6	76.6
Spectrum 2	13.9	5.0	3.4	3.6	77.7
Spectrum 3	15.0	4.6	2.7	3.0	77.7
Spectrum 4	13.6	4.6	3.4	3.6	78.5
Spectrum 5	14.8	4.6	3.3	3.5	77.2
Spectrum 6	13.9	3.7	2.3	2.4	80.1
Mean	14.3	4.4	2.9	3.1	78.0
St. dev.	0.5	0.5	0.5	0.5	1.2

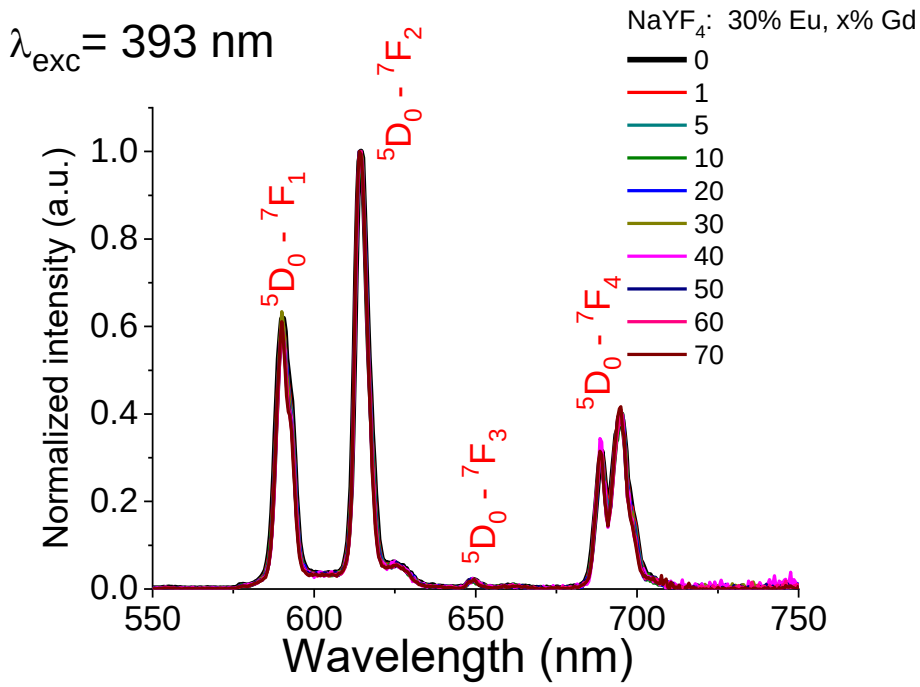


Fig. S4. Emission spectra of $NaYF_4:Eu^{3+}$ 30%, Gd^{3+} concentration series (λ_{ex} = 393 nm) normalized by the maximal intensity.