Supporting Information

Highly sensitive ratiometric luminescence manometer based on the multisite emission of Cr^{3+}

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KEYWORDS luminescent manometer, luminescence thermometry, optical sensors, ratiometric approach

Table S1. Estimated peak centroids of the main Raman modes at pressure values when start to be visible, and the corresponding pressure shift rates of the Raman modes for the $MgGeO_3$ material.

Peak centroid (cm^{-1})	Shift rate (cm^{-1}/GPa)
≈340	3.80 ± 0.12
≈360	2.67 ± 0.09
≈400	3.77 ± 0.25
≈570	4.94 ± 0.16
≈710	3.31 ± 0.11
≈860	4.46 ± 0.23
≈880	4.77 ± 0.19

	≈960	4.10 ± 0.24

$MgGeO_3$:0.1%Cr^{3+}

Global Parameters

Number of used phases:	1
Number of variables:	14
Number of constraints:	0
Zero shift/ °2Theta:	0,000000
Specimen displacement/ mm :	-0,157(1)
Profile function:	Pseudo Voigt
Background:	Polynomial
R (expected)/ %:	0,19313
R (profile)/ %:	1,87123
R (weighted profile)/ %:	3,21522
GOF:	277,16500
d-statistic:	0,65523
U standard:	0,000000
V standard:	0,000000
W standard:	0,010000
U Left:	0,000000
V Left:	0,000000
W Left:	0,010000
U Right:	0,000000
V Right:	0,000000
W Right:	0,010000
Asymmetry Type:	No Asymmetry Function
Asymmetry 1:	0,000000
Asymmetry 2:	0,000000
Shape Type:	Shape Individual
Shape 1 Left:	0,600000
Shape 2 Left:	0,000000
Shape 3 Left:	0,000000
Shape 1 Right:	0,600000
Shape 2 Right:	0,000000
Shape 3 Right:	0,000000
K a1/a2 intensity ratio:	0,500000
K alpha/beta intensity ratio:	0,000000
Crystal Shape Factor K:	1,0000
Instrumental FWHM Curve Type:	Caglioti function
Instr. Gauss Curve Coefficient A:	0,0045(5)
Instr. Gauss Curve Coefficient B:	-0,0032(9)
Instr. Gauss Curve Coefficient C:	0,0046(3)
Instr. Lorentz Curve Coefficient A:	0,0062(7)
Instr. Lorentz Curve Coefficient B:	-0,004(1)
Instr. Lorentz Curve Coefficient C:	0,0064(5)

Relevant parameters of 35533-ICSD, MgGeO3, Pbca

Structure and profile data:	
Formula sum:	$Mg_{16,00}Ge_{16,00}O_{48,00}$
Formula mass/ g/mol:	2318,2910
Density (calculated)/ g/cm^3	4,2745
F(000):	1088,0000
Weight fraction/ %:	100,000000
Space group (No.):	P b c a (61)
Lattice parameters:	
a/ A:	18,8091(5)
b/ A:	8,9588(2)
c/ A:	5,3438(1)
alpha/ °:	90
beta/ °:	90
gamma/ °:	90
V/ 10^6 pm^3	900,47090
Overall displacement parameter:	0,000000
Extinction:	0,000000
Flat Plate Absorption Correction:	0,000000
Porosity:	0,000000

Roughness:	0,000000
Fitting mode:	Structure Fit
U Left:	0,034(7)
V Left:	-0,010(6)
W Left:	0,014(1)
Preferred orientation direction/ hkl:	0,00 0,00 1,00
Preferred orientation parameter:	1,000000
Asymmetry parameter 1:	0,000000
Asymmetry parameter 2:	0,000000
Peak shape:	
parameter 1 Left:	0,65(1)
parameter 2 Left:	0,000000
parameter 3 Left:	0,000000
R (Bragg)/ %:	2,27669

Occupancy, atomic fract. coordinates and Biso for 35533-ICSD, MgGeO3, Pbca

Atom	Wyck.	s.o.f.	x	y	z	B/ 10^4 pm^2
Mg1	8c	1,000000	0,123360	0,656530	0,851890	0,000000
Mg2	8c	1,000000	0,122190	0,488820	0,343520	0,000000
Ge1	8c	1,000000	0,027800	0,339590	0,805350	0,000000
Ge2	8c	1,000000	0,229070	0,345090	0,041410	0,000000
O1	8c	1,000000	0,935450	0,338430	0,814780	0,000000
O2	8c	1,000000	0,069360	0,488810	0,670450	0,000000
O3	8c	1,000000	0,055450	0,319810	0,125190	0,000000
O4	8c	1,000000	0,320480	0,340070	0,021910	0,000000
O5	8c	1,000000	0,187680	0,514400	0,033320	0,000000
O6	8c	1,000000	0,193260	0,289580	0,336850	0,000000

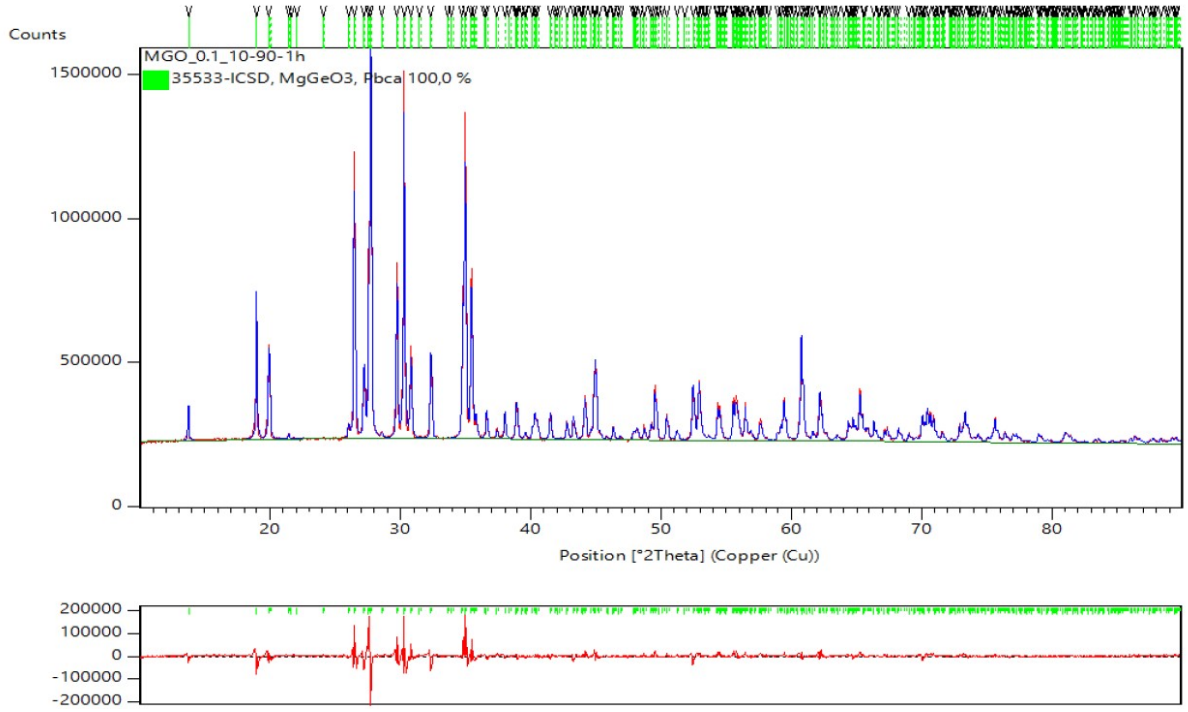

Figure S1. Rietveld refinement of XRD pattern of $MgGeO_3$:0.1%Cr^{3+}.

$MgGeO_3$:0.5%Cr^{3+}

Global Parameters

Number of used phases:	1
Number of variables:	14
Number of constraints:	0
Zero shift/ °2Theta:	0,000000
Specimen displacement/ mm :	-0,098(1)
Profile function:	Pseudo Voigt
Background:	Polynomial
R (expected)/ %:	0,19064
R (profile)/ %:	1,96927
R (weighted profile)/ %:	3,36953
GOF:	312,39200
d-statistic:	0,66770
U standard:	0,000000
V standard:	0,000000
W standard:	0,010000
U Left:	0,000000
V Left:	0,000000
W Left:	0,010000
U Right:	0,000000
V Right:	0,000000
W Right:	0,010000
Asymmetry Type:	No Asymmetry Function
Asymmetry 1:	0,000000
Asymmetry 2:	0,000000
Shape Type:	Shape Individual
Shape 1 Left:	0,600000
Shape 2 Left:	0,000000
Shape 3 Left:	0,000000
Shape 1 Right:	0,600000
Shape 2 Right:	0,000000
Shape 3 Right:	0,000000
K a1/a2 intensity ratio:	0,500000
K alpha/beta intensity ratio:	0,000000
Crystal Shape Factor K:	1,0000
Instrumental FWHM Curve Type:	Caglioti function
Instr. Gauss Curve Coefficient A:	0,0045(5)
Instr. Gauss Curve Coefficient B:	-0,0032(9)
Instr. Gauss Curve Coefficient C:	0,0046(3)
Instr. Lorentz Curve Coefficient A:	0,0062(7)
Instr. Lorentz Curve Coefficient B:	-0,004(1)
Instr. Lorentz Curve Coefficient C:	0,0064(5)

Relevant parameters of 35533-ICSD, MgGeO3, Pbca

Structure and profile data:	
Formula sum:	$Mg_{16,00}Ge_{16,00}O_{48,00}$
Formula mass/ g/mol:	2318,2910
Density (calculated)/ g/cm^3	4,2746
F(000):	1088,0000
Weight fraction/ %:	100,000000
Space group (No.):	P b c a (61)
Lattice parameters:	
a/ A:	18,8114(5)
b/ A:	8,9575(2)
c/ A:	5,3439(1)
alpha/ °:	90
beta/ °:	90
gamma/ °:	90
V/ 10^6 pm^3	900,45860
Overall displacement parameter:	0,000000
Extinction:	0,000000
Flat Plate Absorption Correction:	0,000000
Porosity:	0,000000
Roughness:	0,000000
Fitting mode:	Structure Fit
U Left:	0,034(8)
V Left:	-0,010(6)
W Left:	0,014(1)
Preferred orientation direction/ hkl:	0,00 0,00 1,00
Preferred orientation parameter:	1,000000
Asymmetry parameter 1:	0,000000

Asymmetry parameter 2:	0,000000
Peak shape:	
parameter 1 Left:	0,66(1)
parameter 2 Left:	0,000000
parameter 3 Left:	0,000000
R (Bragg)/ %:	2,53705

Occupancy, atomic fract. coordinates and Biso for 35533-ICSD, MgGeO3, Pbca

Atom	Wyck.	s.o.f.	x	y	z	B/ 10^4 pm^2
Mg1	8c	1,000000	0,123360	0,656530	0,851890	0,000000
Mg2	8c	1,000000	0,122190	0,488820	0,343520	0,000000
Ge1	8c	1,000000	0,027800	0,339590	0,805350	0,000000
Ge2	8c	1,000000	0,229070	0,345090	0,041410	0,000000
O1	8c	1,000000	0,935450	0,338430	0,814780	0,000000
O2	8c	1,000000	0,069360	0,488810	0,670450	0,000000
O3	8c	1,000000	0,055450	0,319810	0,125190	0,000000
O4	8c	1,000000	0,320480	0,340070	0,021910	0,000000
O5	8c	1,000000	0,187680	0,514400	0,033320	0,000000
O6	8c	1,000000	0,193260	0,289580	0,336850	0,000000

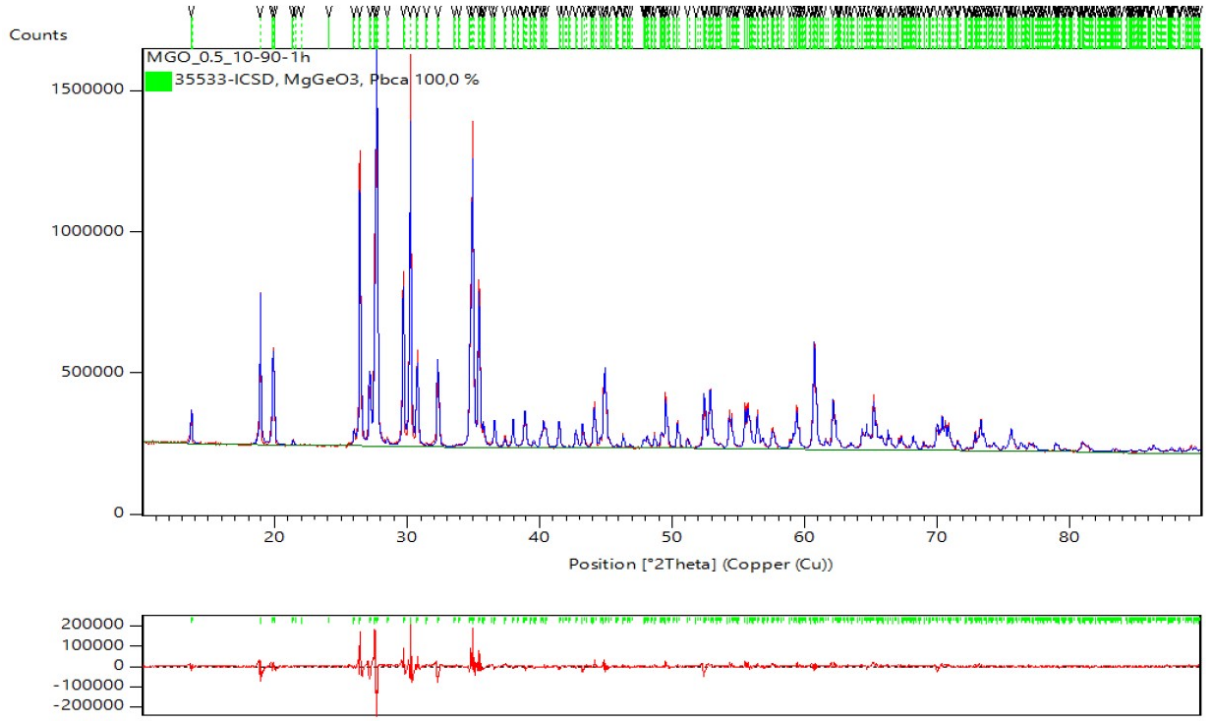

Figure S2. Rietveld refinement of XRD pattern of $MgGeO_3$:0.5%Cr^{3+}.

$MgGeO_3$:1%Cr^{3+}

Global Parameters

Number of used phases:	1
Number of variables:	14
Number of constraints:	0
Zero shift/ °2Theta:	0,000000

Specimen displacement/ mm :	-0,184(1)
Profile function:	Pseudo Voigt
Background:	Polynomial
R (expected)/ %:	0,19091
R (profile)/ %:	2,04571
R (weighted profile)/ %:	3,50891
GOF:	337,80620
d-statistic:	0,57519
U standard:	0,000000
V standard:	0,000000
W standard:	0,010000
U Left:	0,000000
V Left:	0,000000
W Left:	0,010000
U Right:	0,000000
V Right:	0,000000
W Right:	0,010000
Asymmetry Type:	No Asymmetry Function
Asymmetry 1:	0,000000
Asymmetry 2:	0,000000
Shape Type:	Shape Individual
Shape 1 Left:	0,600000
Shape 2 Left:	0,000000
Shape 3 Left:	0,000000
Shape 1 Right:	0,600000
Shape 2 Right:	0,000000
Shape 3 Right:	0,000000
K a1/a2 intensity ratio:	0,500000
K alpha/beta intensity ratio:	0,000000
Crystal Shape Factor K:	1,0000
Instrumental FWHM Curve Type:	Caglioti function
Instr. Gauss Curve Coefficient A:	0,0045(5)
Instr. Gauss Curve Coefficient B:	-0,0032(9)
Instr. Gauss Curve Coefficient C:	0,0046(3)
Instr. Lorentz Curve Coefficient A:	0,0062(7)
Instr. Lorentz Curve Coefficient B:	-0,004(1)
Instr. Lorentz Curve Coefficient C:	0,0064(5)

Relevant parameters of 35533-ICSD, MgGeO3, Pbca

Structure and profile data:	
Formula sum:	$Mg_{16,00}Ge_{16,00}O_{48,00}$
Formula mass/ g/mol:	2318,2910
Density (calculated)/ g/cm^3	4,2744
F(000):	1088,0000
Weight fraction/ %:	100,000000
Space group (No.):	P b c a (61)
Lattice parameters:	
a/ A:	18,8111(5)
b/ A:	8,9575(2)
c/ A:	5,3441(1)
alpha/ °:	90
beta/ °:	90
gamma/ °:	90
V/ 10^6 pm^3	900,49250
Overall displacement parameter:	0,000000
Extinction:	0,000000
Flat Plate Absorption Correction:	0,000000
Porosity:	0,000000
Roughness:	0,000000
Fitting mode:	Structure Fit
U Left:	0,033(8)
V Left:	-0,010(7)
W Left:	0,014(1)
Preferred orientation direction/ hkl:	0,00 0,00 1,00
Preferred orientation parameter:	1,000000
Asymmetry parameter 1:	0,000000
Asymmetry parameter 2:	0,000000
Peak shape:	
parameter 1 Left:	0,63(1)
parameter 2 Left:	0,000000
parameter 3 Left:	0,000000
R (Bragg)/ %:	2,71266

Occupancy, atomic fract. coordinates and Biso for 35533-ICSD, MgGeO3, Pbca

Atom	Wyck.	s.o.f.	x	y	z	B/ 10^4 pm^2
Mg1	8c	1,000000	0,123360	0,656530	0,851890	0,000000
Mg2	8c	1,000000	0,122190	0,488820	0,343520	0,000000
Ge1	8c	1,000000	0,027800	0,339590	0,805350	0,000000
Ge2	8c	1,000000	0,229070	0,345090	0,041410	0,000000
O1	8c	1,000000	0,935450	0,338430	0,814780	0,000000
O2	8c	1,000000	0,069360	0,488810	0,670450	0,000000
O3	8c	1,000000	0,055450	0,319810	0,125190	0,000000
O4	8c	1,000000	0,320480	0,340070	0,021910	0,000000
O5	8c	1,000000	0,187680	0,514400	0,033320	0,000000
O6	8c	1,000000	0,193260	0,289580	0,336850	0,000000

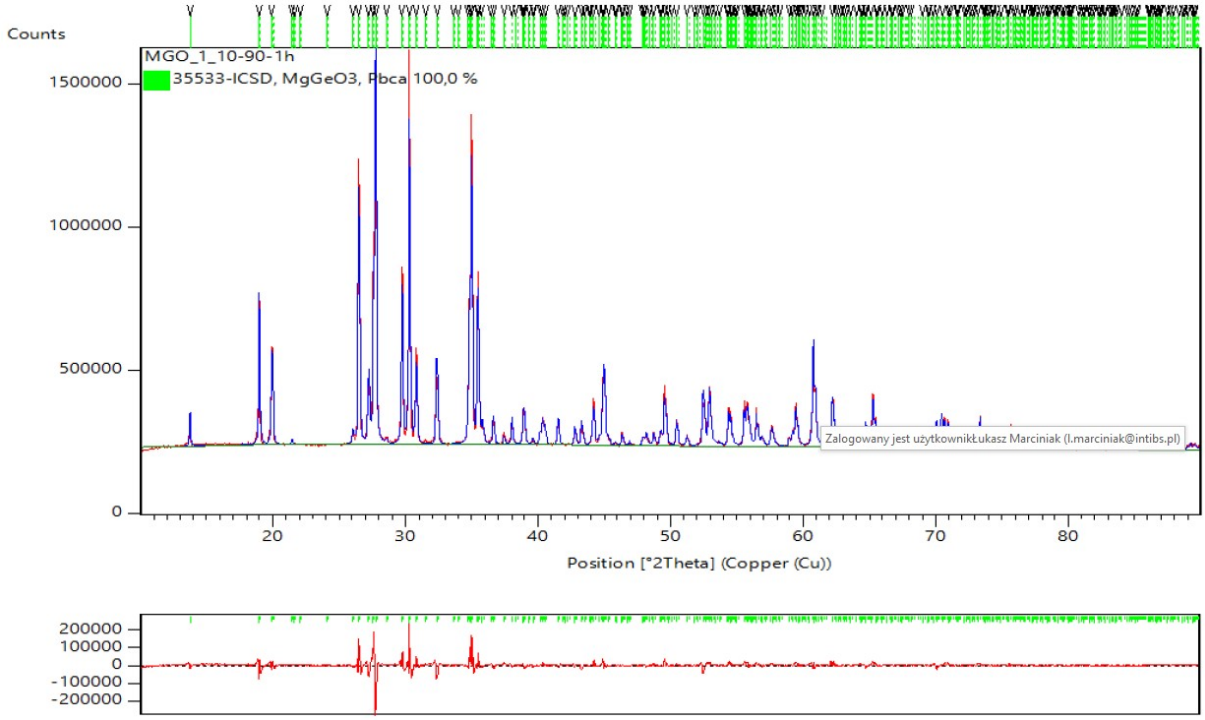

Figure S3. Rietveld refinement of XRD pattern of $MgGeO_3$:1%Cr^{3+}.

$MgGeO_3$:2%Cr^{3+}

Global Parameters

Number of used phases:	1
Number of variables:	14
Number of constraints:	0
Zero shift/ °2Theta:	0,000000
Specimen displacement/ mm :	-0,076(1)
Profile function:	Pseudo Voigt
Background:	Polynomial
R (expected)/ %:	0,19556

R (profile)/ %:	2,05567
R (weighted profile)/ %:	3,66397
GOF:	351,04610
d-statistic:	0,56927
U standard:	0,000000
V standard:	0,000000
W standard:	0,010000
U Left:	0,000000
V Left:	0,000000
W Left:	0,010000
U Right:	0,000000
V Right:	0,000000
W Right:	0,010000
Asymmetry Type:	No Asymmetry Function
Asymmetry 1:	0,000000
Asymmetry 2:	0,000000
Shape Type:	Shape Individual
Shape 1 Left:	0,600000
Shape 2 Left:	0,000000
Shape 3 Left:	0,000000
Shape 1 Right:	0,600000
Shape 2 Right:	0,000000
Shape 3 Right:	0,000000
K a1/a2 intensity ratio:	0,500000
K alpha/beta intensity ratio:	0,000000
Crystal Shape Factor K:	1,0000
Instrumental FWHM Curve Type:	Caglioti function
Instr. Gauss Curve Coefficient A:	0,0045(5)
Instr. Gauss Curve Coefficient B:	-0,0032(9)
Instr. Gauss Curve Coefficient C:	0,0046(3)
Instr. Lorentz Curve Coefficient A:	0,0062(7)
Instr. Lorentz Curve Coefficient B:	-0,004(1)
Instr. Lorentz Curve Coefficient C:	0,0064(5)

Relevant parameters of 35533-ICSD, MgGeO3, Pbca

Structure and profile data:	
Formula sum:	$Mg_{16,00}Ge_{16,00}O_{48,00}$
Formula mass/ g/mol:	2318,2910
Density (calculated)/ g/cm^3	4,2742
F(000):	1088,0000
Weight fraction/ %:	100,000000
Space group (No.):	P b c a (61)
Lattice parameters:	
a/ A:	18,8114(5)
b/ A:	8,9576(3)
c/ A:	5,3442(2)
alpha/ °:	90
beta/ °:	90
gamma/ °:	90
V/ 10^6 pm^3	900,52460
Overall displacement parameter:	0,000000
Extinction:	0,000000
Flat Plate Absorption Correction:	0,000000
Porosity:	0,000000
Roughness:	0,000000
Fitting mode:	Structure Fit
U Left:	0,035(9)
V Left:	-0,010(7)
W Left:	0,014(1)
Preferred orientation direction/ hkl:	0,00 0,00 1,00
Preferred orientation parameter:	1,000000
Asymmetry parameter 1:	0,000000
Asymmetry parameter 2:	0,000000
Peak shape:	
parameter 1 Left:	0,64(1)
parameter 2 Left:	0,000000
parameter 3 Left:	0,000000
R (Bragg)/ %:	2,90631

Occupancy, atomic fract. coordinates and Biso for 35533-ICSD, MgGeO3, Pbca

Atom	Wyck.	s.o.f.	x	y	z	B/ 10^4 pm^2	
Mg1	8c	1,000000	0,123360	0,656530	0,851890	0,000000	

Mg2	8c	1,000000	0,122190	0,488820	0,343520	0,000000
Ge1	8c	1,000000	0,027800	0,339590	0,805350	0,000000
Ge2	8c	1,000000	0,229070	0,345090	0,041410	0,000000
O1	8c	1,000000	0,935450	0,338430	0,814780	0,000000
O2	8c	1,000000	0,069360	0,488810	0,670450	0,000000
O3	8c	1,000000	0,055450	0,319810	0,125190	0,000000
O4	8c	1,000000	0,320480	0,340070	0,021910	0,000000
O5	8c	1,000000	0,187680	0,514400	0,033320	0,000000
O6	8c	1,000000	0,193260	0,289580	0,336850	0,000000

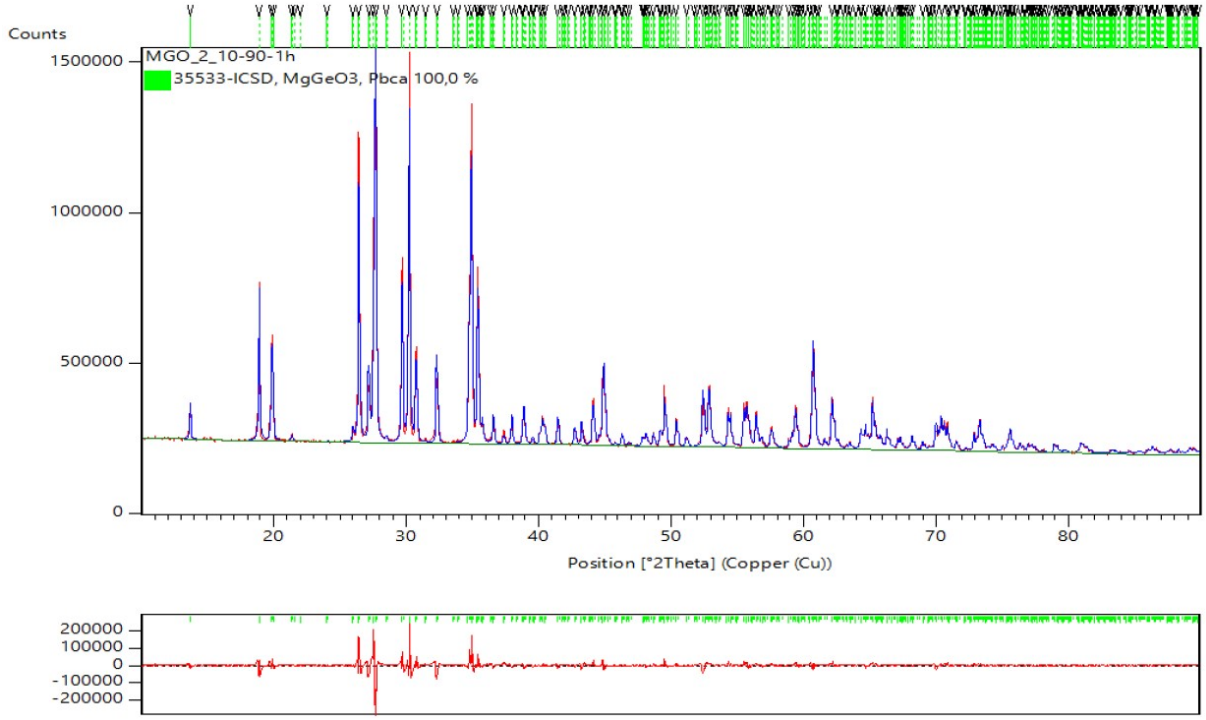

Figure S4. Rietveld refinement of XRD pattern of $MgGeO_3$:2%Cr^{3+}.

$MgGeO_3$:5%Cr^{3+}

Global Parameters

Number of used phases:	1
Number of variables:	14
Number of constraints:	0
Zero shift/ °2Theta:	0,000000
Specimen displacement/ mm :	-0,051(2)
Profile function:	Pseudo Voigt
Background:	Polynomial
R (expected)/ %:	0,20980
R (profile)/ %:	2,56354
R (weighted profile)/ %:	3,93195
GOF:	351,25220
d-statistic:	0,45203
U standard:	0,000000
V standard:	0,000000
W standard:	0,010000

U Left:	0,000000
V Left:	0,000000
W Left:	0,010000
U Right:	0,000000
V Right:	0,000000
W Right:	0,010000
Asymmetry Type:	No Asymmetry Function
Asymmetry 1:	0,000000
Asymmetry 2:	0,000000
Shape Type:	Shape Individual
Shape 1 Left:	0,600000
Shape 2 Left:	0,000000
Shape 3 Left:	0,000000
Shape 1 Right:	0,600000
Shape 2 Right:	0,000000
Shape 3 Right:	0,000000
K a1/a2 intensity ratio:	0,500000
K alpha/beta intensity ratio:	0,000000
Crystal Shape Factor K:	1,0000
Instrumental FWHM Curve Type:	Caglioti function
Instr. Gauss Curve Coefficient A:	0,0045(5)
Instr. Gauss Curve Coefficient B:	-0,0032(9)
Instr. Gauss Curve Coefficient C:	0,0046(3)
Instr. Lorentz Curve Coefficient A:	0,0062(7)
Instr. Lorentz Curve Coefficient B:	-0,004(1)
Instr. Lorentz Curve Coefficient C:	0,0064(5)

Relevant parameters of 35533-ICSD, MgGeO3, Pbca

Structure and profile data:	
Formula sum:	$Mg_{16,00}Ge_{16,00}O_{48,00}$
Formula mass/ g/mol:	2318,2910
Density (calculated)/ g/cm^3	4,2735
F(000):	1088,0000
Weight fraction/ %:	100,000000
Space group (No.):	P b c a (61)
Lattice parameters:	
a/ A:	18,8102(6)
b/ A:	8,9594(3)
c/ A:	5,3444(2)
alpha/ °:	90
beta/ °:	90
gamma/ °:	90
V/ 10^6 pm^3	900,68280
Overall displacement parameter:	0,000000
Extinction:	0,000000
Flat Plate Absorption Correction:	0,000000
Porosity:	0,000000
Roughness:	0,000000
Fitting mode:	Structure Fit
U Left:	0,04(1)
V Left:	-0,012(9)
W Left:	0,014(2)
Preferred orientation direction/ hkl:	0,00 0,00 1,00
Preferred orientation parameter:	1,000000
Asymmetry parameter 1:	0,000000
Asymmetry parameter 2:	0,000000
Peak shape:	
parameter 1 Left:	0,63(2)
parameter 2 Left:	0,000000
parameter 3 Left:	0,000000
R (Bragg)/ %:	2,83244

Occupancy, atomic fract. coordinates and Biso for 35533-ICSD, MgGeO3, Pbca

Atom	Wyck.	s.o.f.	x	y	z	B/ 10^4 pm^2
Mg1	8c	1,000000	0,123360	0,656530	0,851890	0,000000
Mg2	8c	1,000000	0,122190	0,488820	0,343520	0,000000
Ge1	8c	1,000000	0,027800	0,339590	0,805350	0,000000
Ge2	8c	1,000000	0,229070	0,345090	0,041410	0,000000
O1	8c	1,000000	0,935450	0,338430	0,814780	0,000000
O2	8c	1,000000	0,069360	0,488810	0,670450	0,000000

O3	8c	1,000000	0,055450	0,319810	0,125190	0,000000
O4	8c	1,000000	0,320480	0,340070	0,021910	0,000000
O5	8c	1,000000	0,187680	0,514400	0,033320	0,000000
O6	8c	1,000000	0,193260	0,289580	0,336850	0,000000

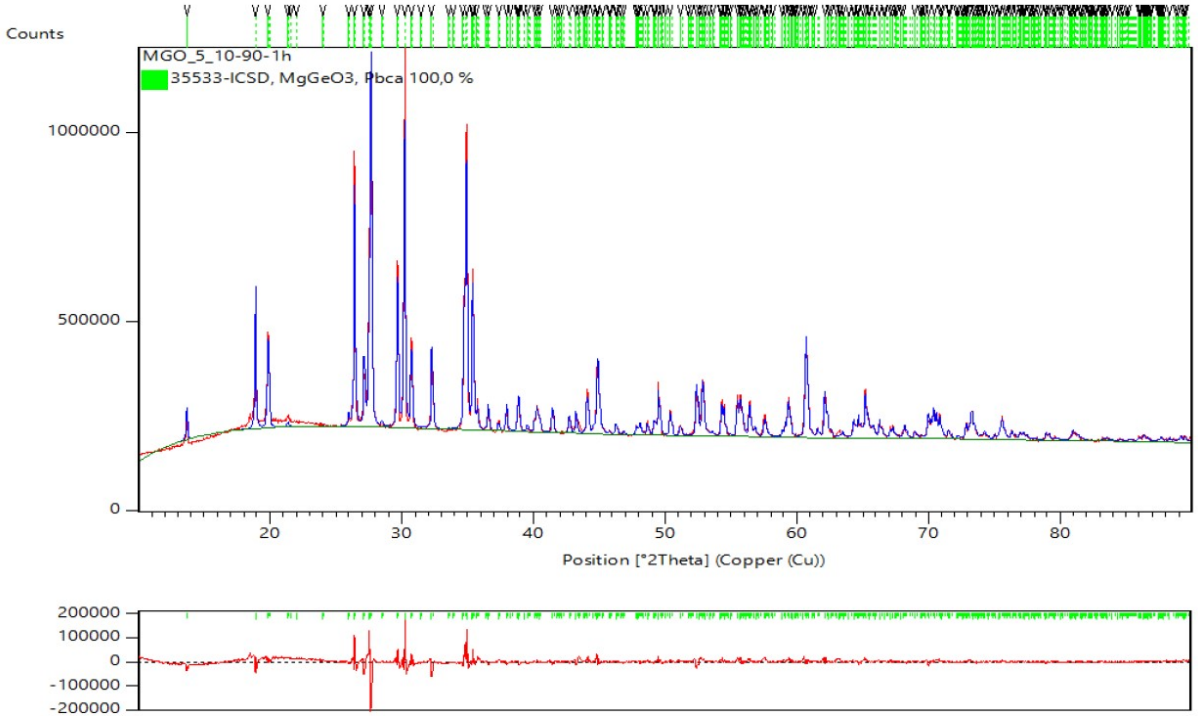

Figure S5. Rietveld refinement of XRD pattern of $MgGeO_3$:5%Cr^{3+}.

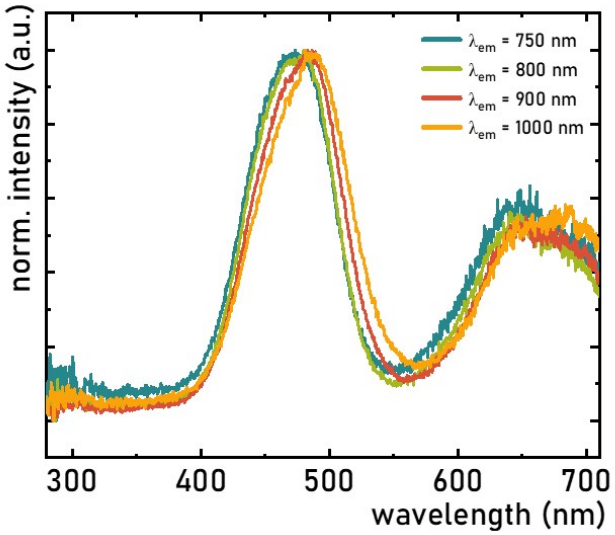

Figure S6. Room-temperature excitation spectra as a function of λ_{em} for the $MgGeO_3$:5%Cr^{3+} (λ_{exc} = 445 nm).

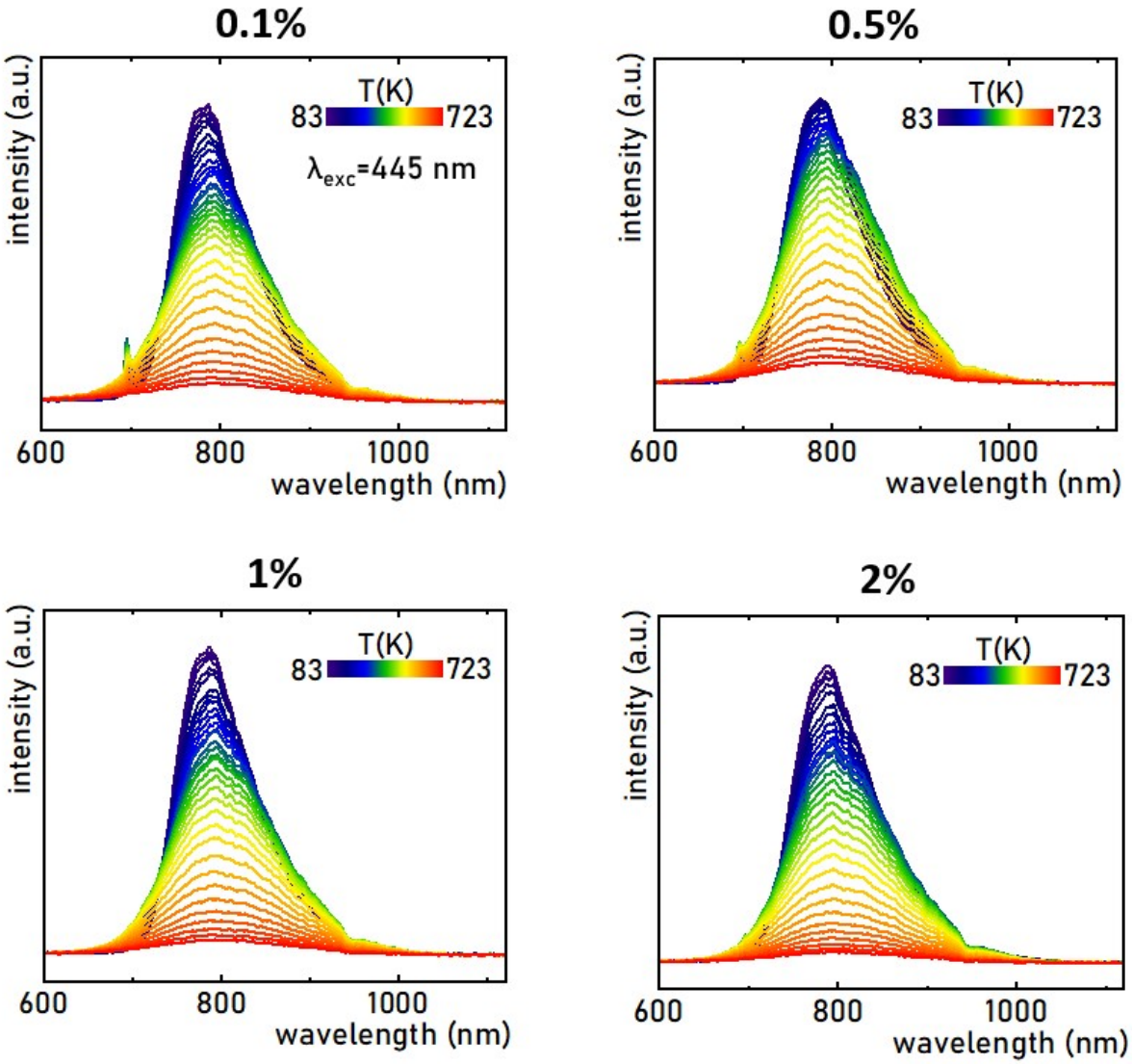

Figure S7. Temperature-dependent emission spectra for the $MgGeO_3$ doped with various Cr^{3+} concentration (0,1, 0.5, 1, 2%) upon λ_{exc} = 445 nm.

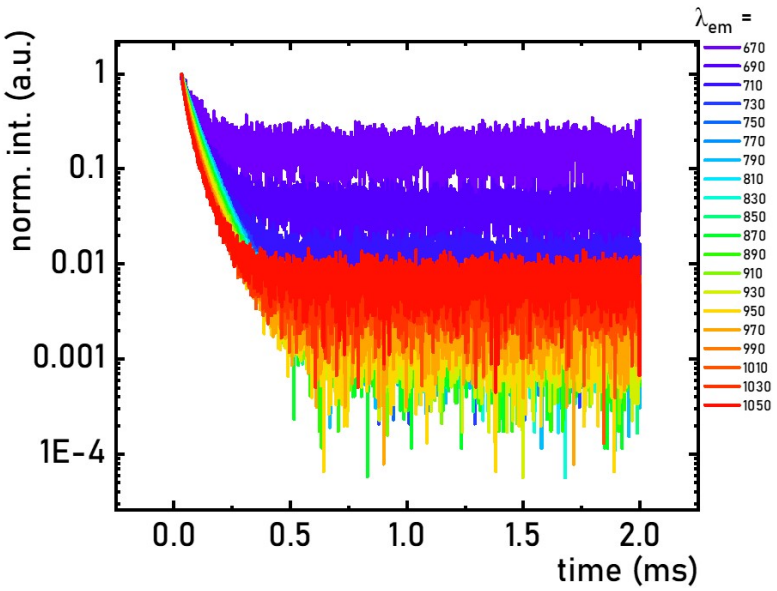

Figure S8. Room-temperature decay curves as a function of λ_{em} for the $MgGeO_3$:1%Cr^{3+}.

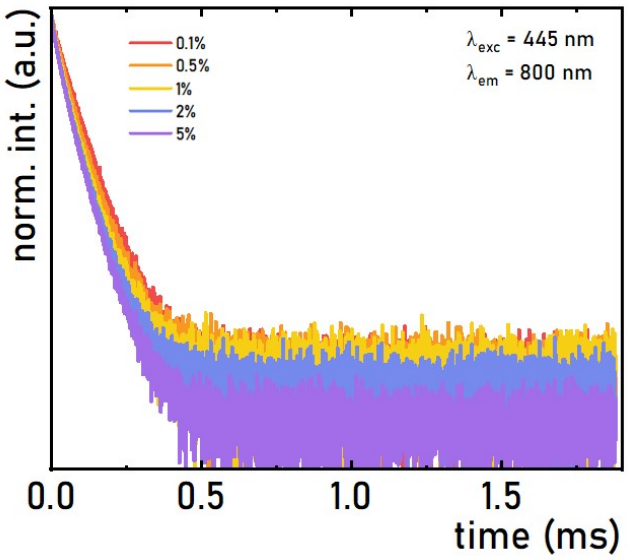

Figure S9. Room-temperature decay curves as a function of Cr^{3+} concentration in doped $MgGeO_3$ (λ_{exc} = 445 nm.