Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

New insight into rare-earth doped gadolinium molybdate nanophosphor assisted broad spectral converter from UV to NIR for silicon solar cell

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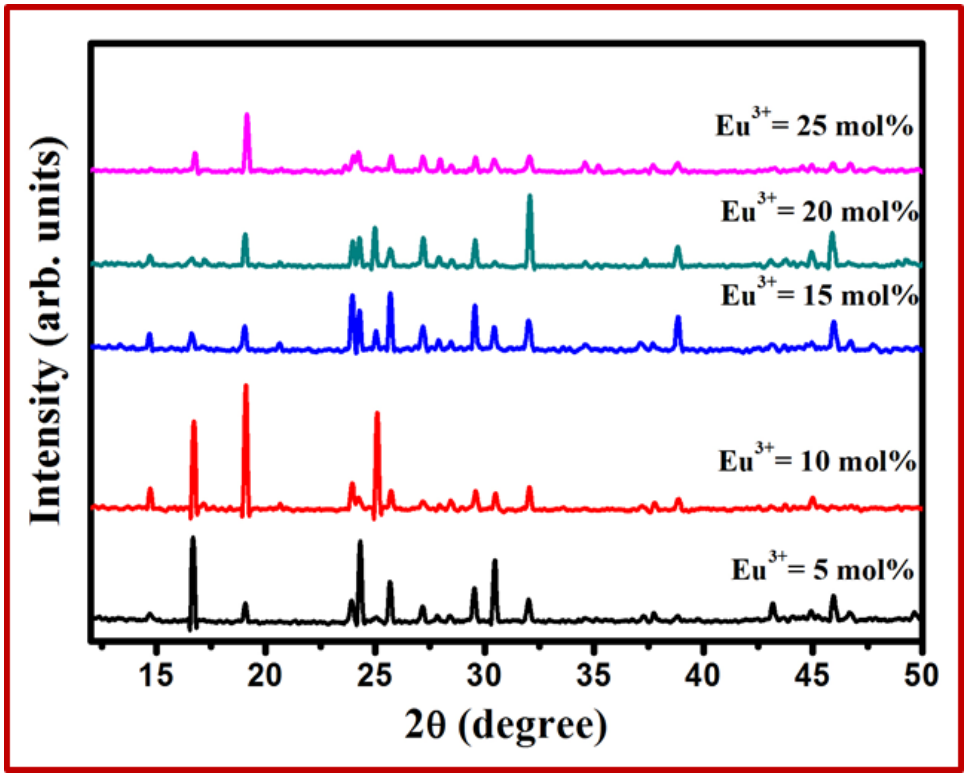

Fig. S1: The XRD patterns of $Gd_{2-x}(MoO_4)_3:Eu_x^{3+}$downshift nanophosphor at different concentration(x=0.1 to 0.5).

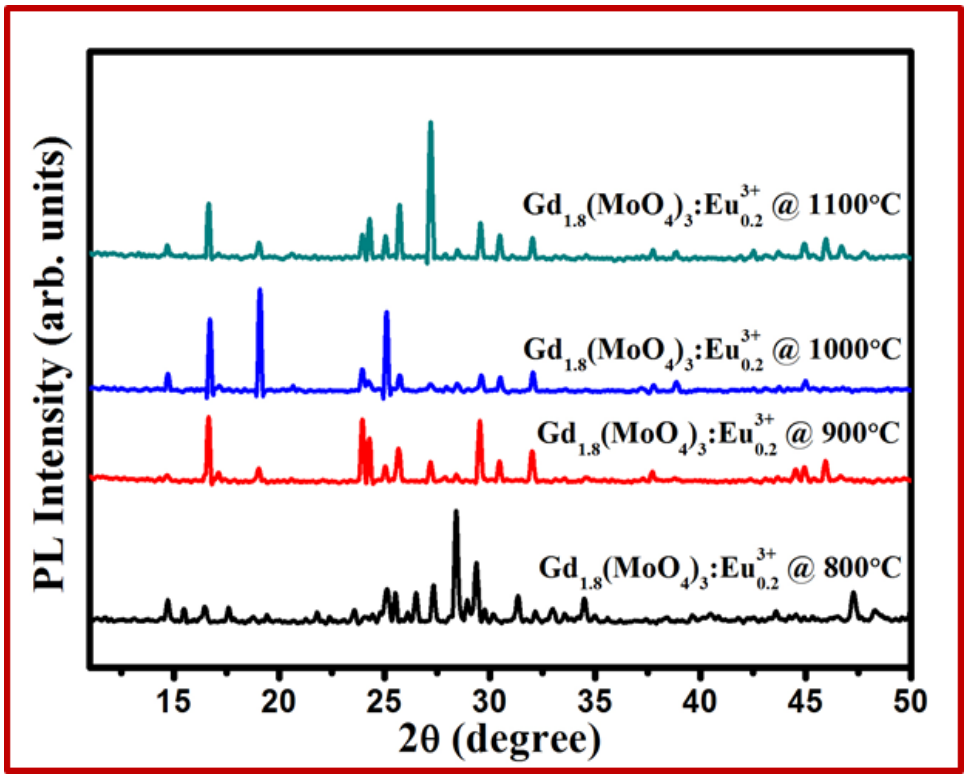

Fig. S2: The XRD patterns of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$downshift nanophosphor at different sintering temperatures (800 to 1100°C).

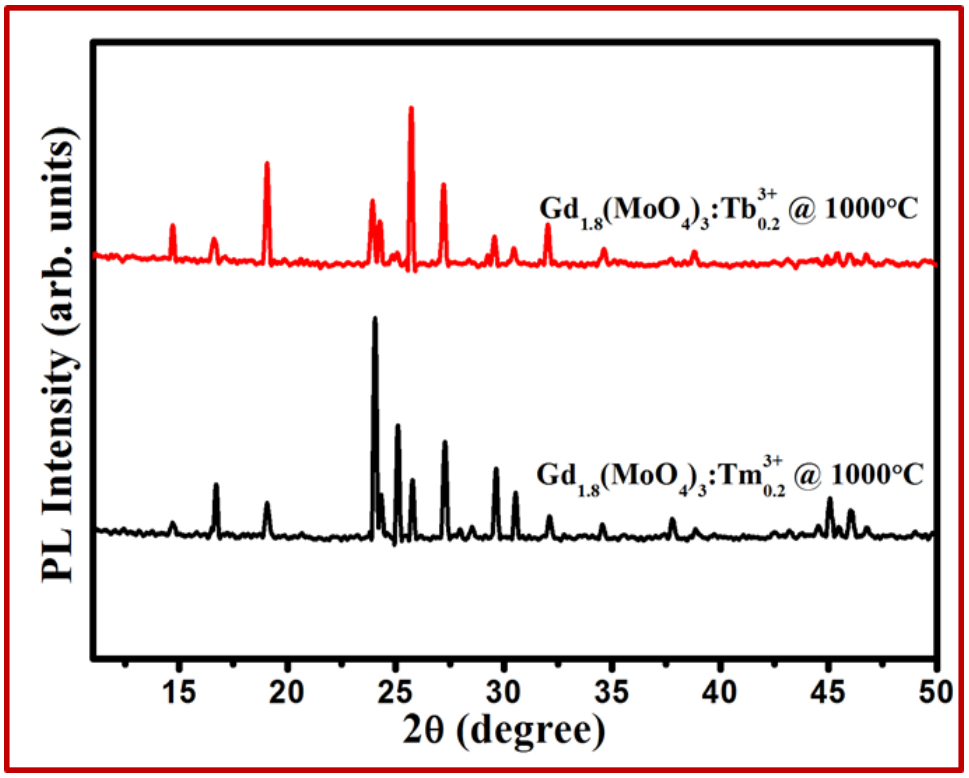

Fig. S3: The XRD patterns of $Gd_{1.8}(MoO_4)_3:Tb_{0.2}^{3+}$ and $Gd_{1.8}(MoO_4)_3:Tm_{0.2}^{3+}$ downshift nanophosphors at 1000 °C sintering temperature.

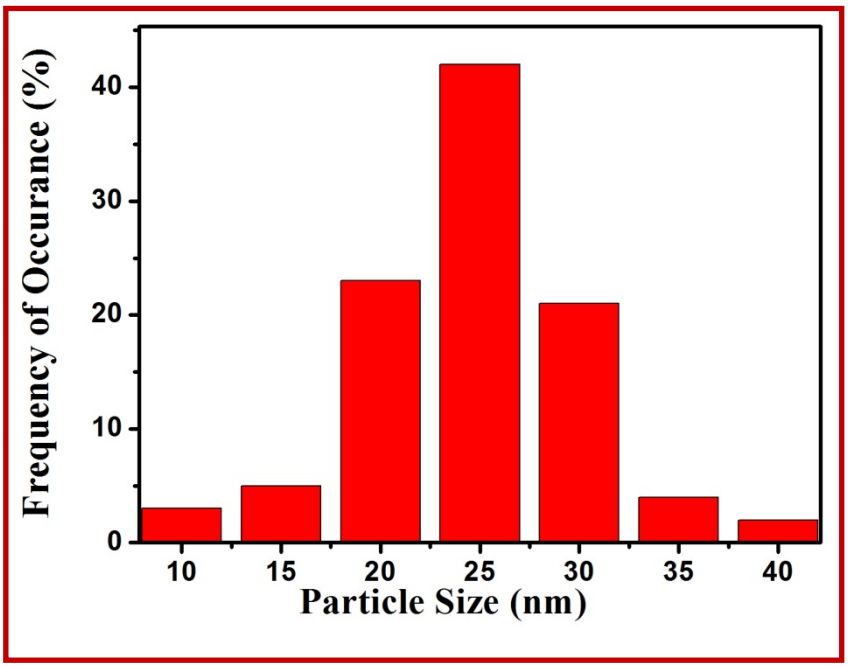

Fig. S4: The statistic histogram for size distribution of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$ downshift nanophosphor.

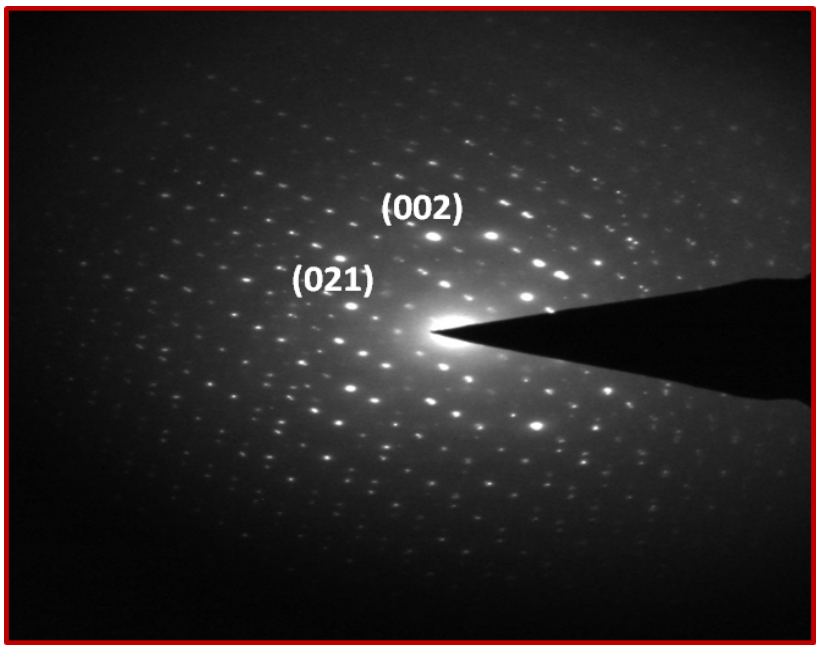

Fig. S5: The SAED pattern of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$downshift nanophosphor.

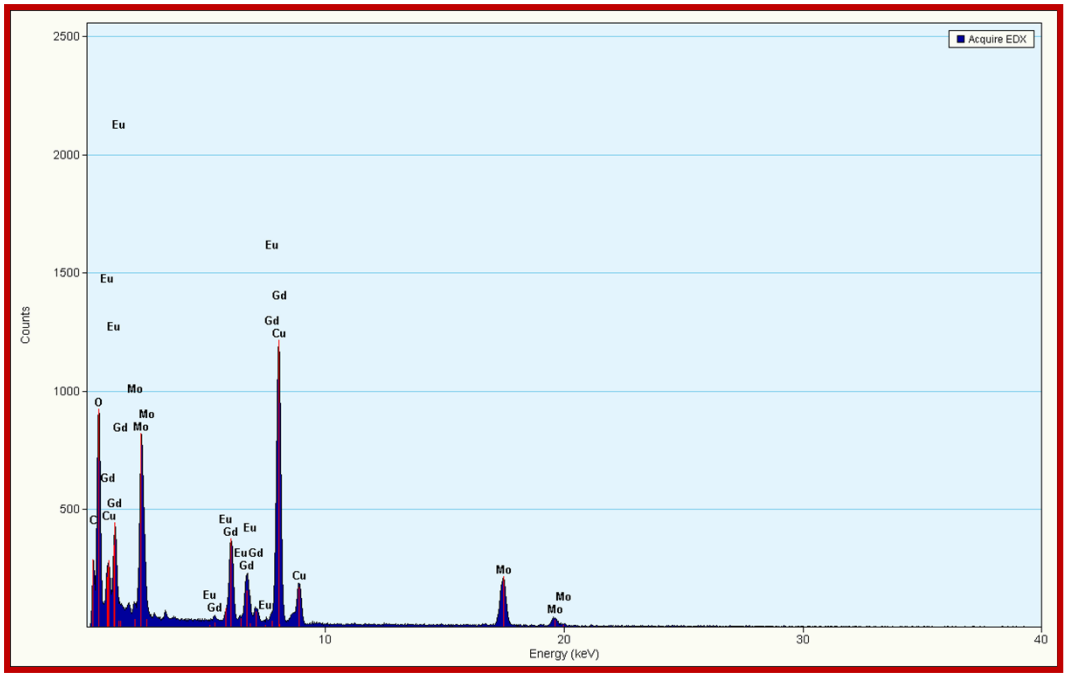

Fig. S6: The EDAX spectrum of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$downshift nanophosphor.

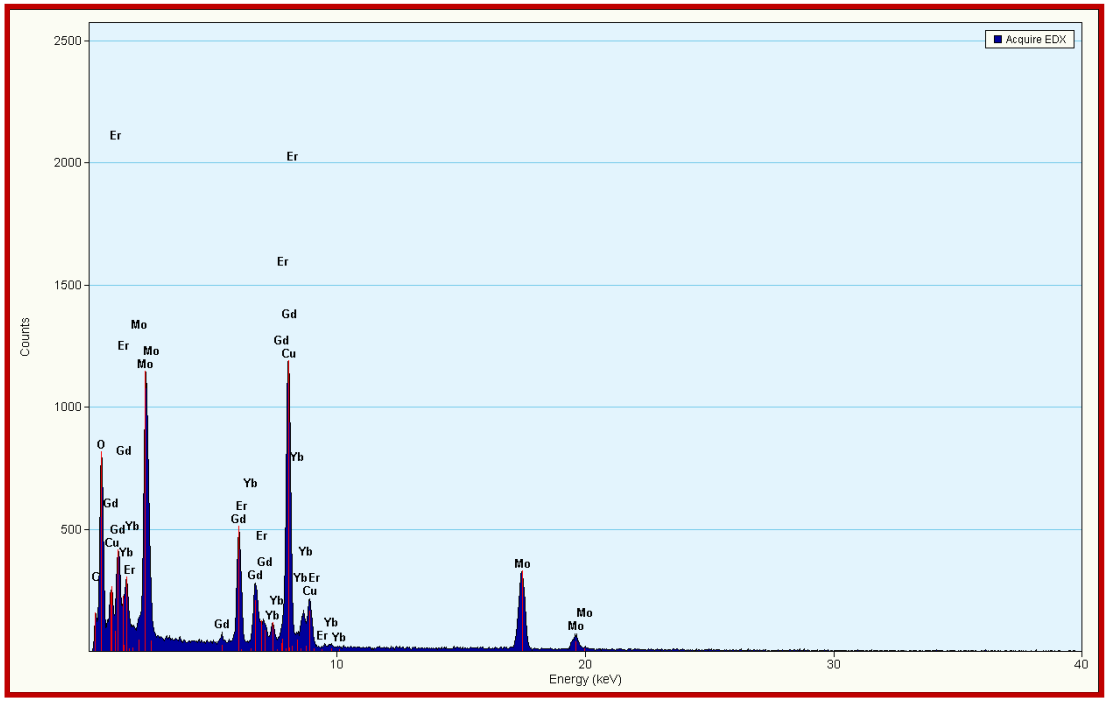

Fig. S7: The EDAX spectrum of $Gd_2(MoO_4)_3:Er^{3+/}Yb^{3+}$upconversion nanophosphor.

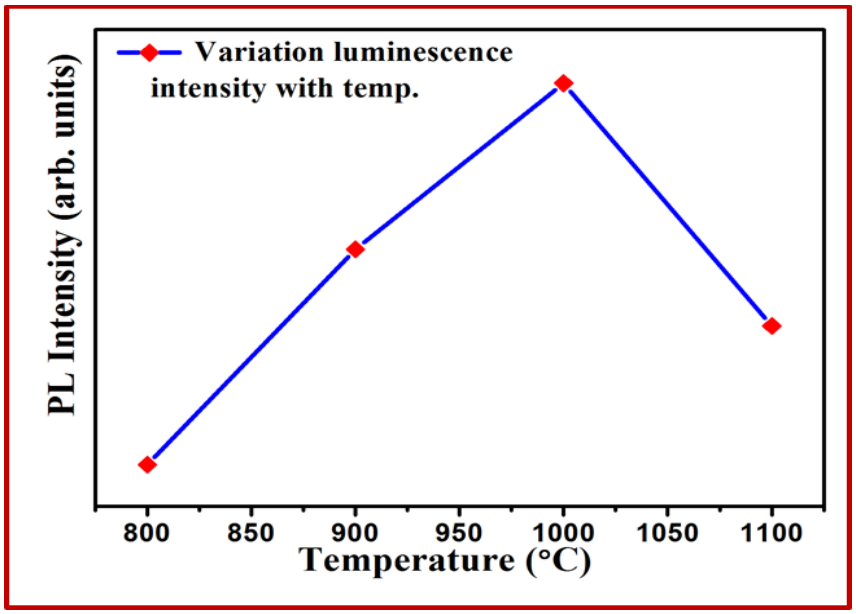

Fig. S8: The variation in PL emission intensity of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$downshift nanophosphor at different sintering temperature (800 to1100°C).

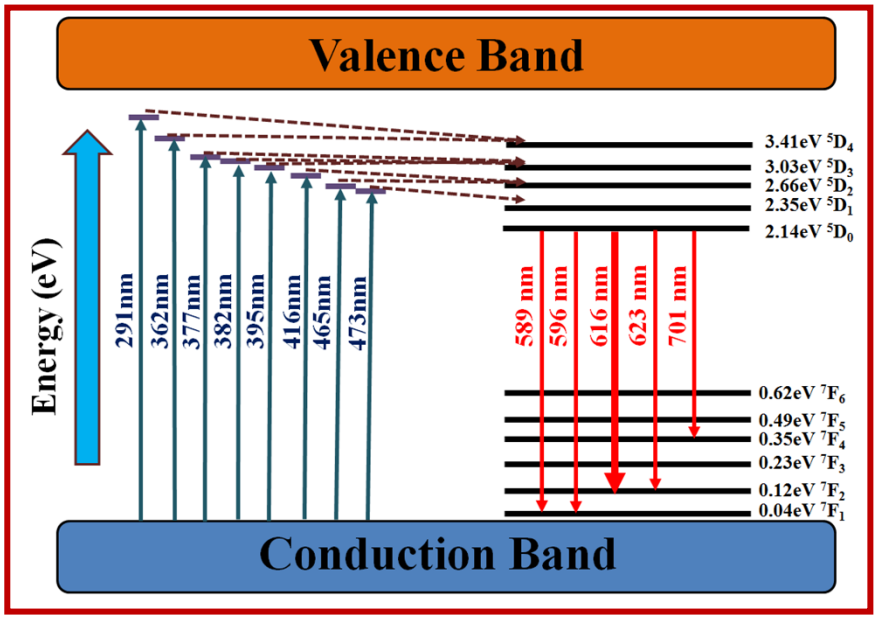

Fig. S9: The energy level diagram for downshift process in$Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$ nanophosphor.

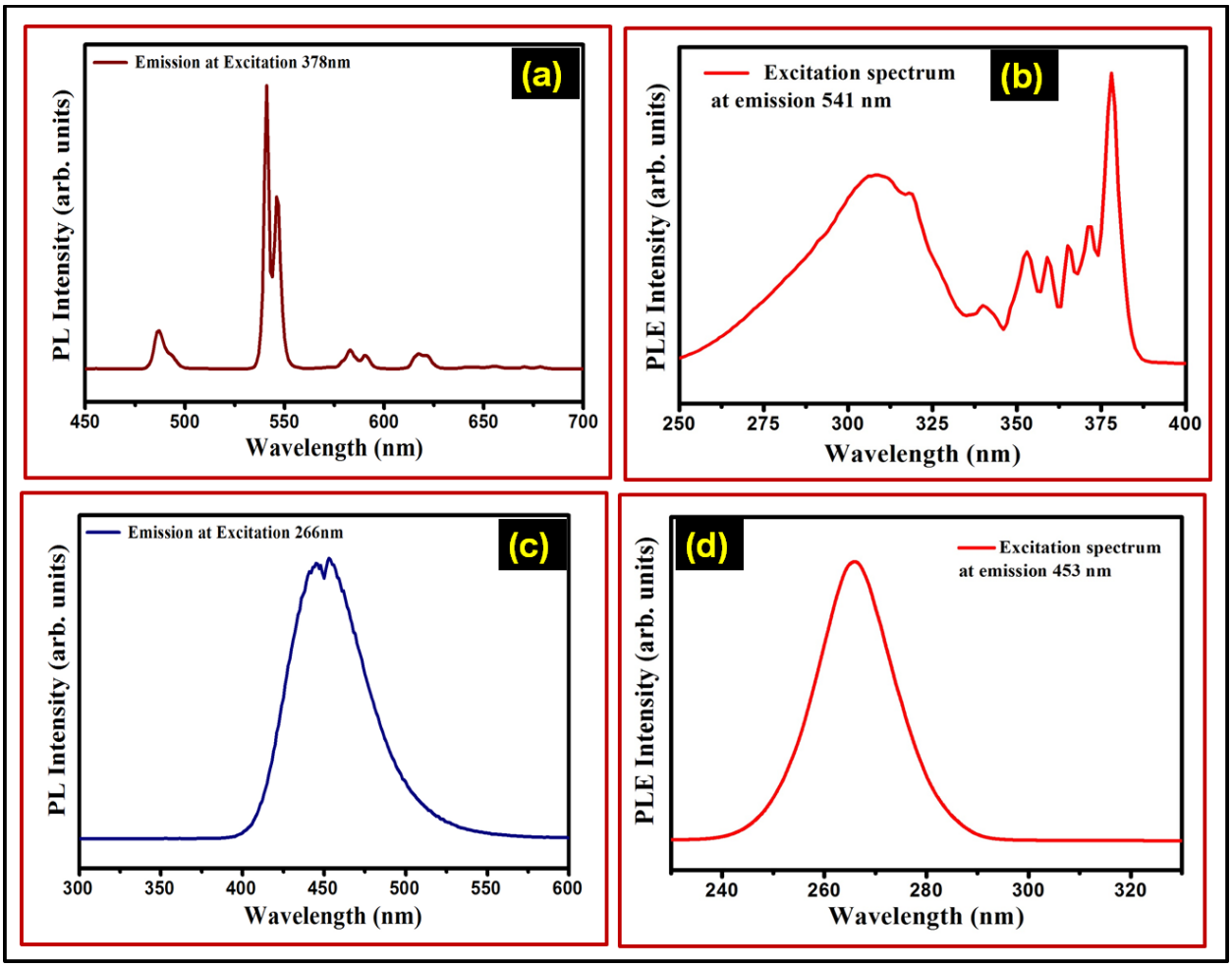

Fig. S10: (a) emission spectrum of $Gd_{1.8}(MoO_4)_3:Tb_{0.2}^{3+}$downshift nanophosphor, (b)excitation spectrum of $Gd_{1.8}(MoO_4)_3:Tb_{0.2}^{3+}$downshift nanophosphor at 541 nm emission wavelength, (c) emission spectrum of $Gd_{1.8}(MoO_4)_3:Tm_{0.2}^{3+}$downshift nanophosphor and (d) The excitation spectrum of $Gd_{1.8}(MoO_4)_3:Tm_{0.2}^{3+}$ downshift nanophosphor at 453 nm emission wavelength.

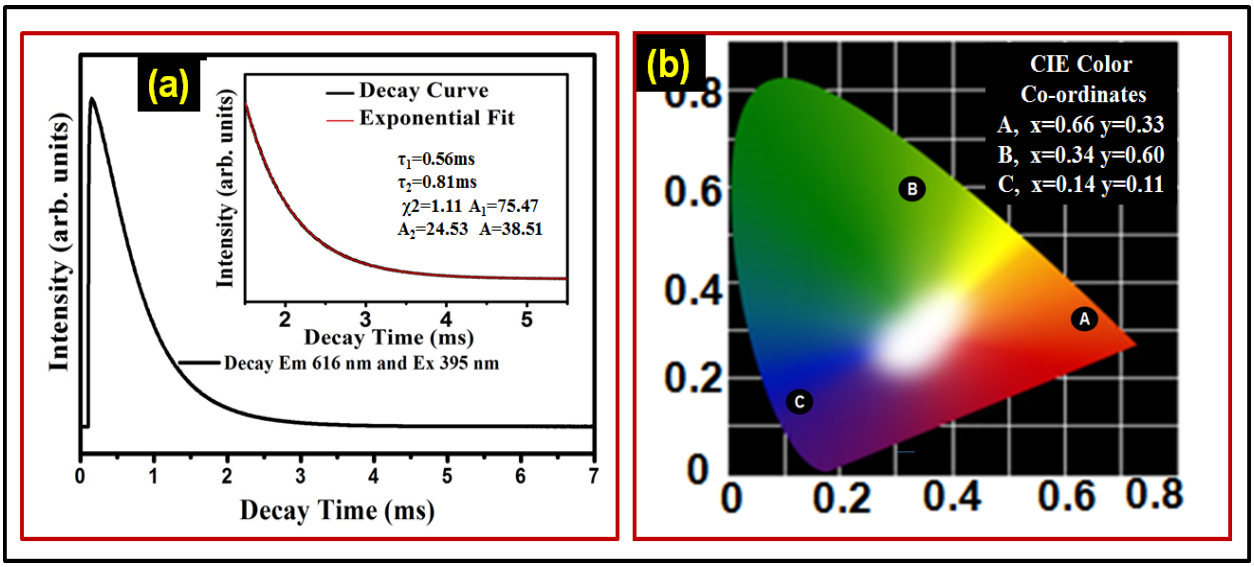

Fig. S11: (a) The time resolved PL decay profile of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$ downshift nanophosphor recorded at room temperature while monitoring the emission at 616 nm at 395 nm excitation wavelength and inset shows the exponential fitting of decay profile which gives the lifetime data and the generated parameters after exponential fitting and (b) the CIE colour co-ordinates of $Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$, $Gd_{1.8}(MoO_4)_3:Tb_{0.2}^{3+}$and $Gd_{1.8}(MoO_4)_3:Tm_{0.2}^{3+}$downshift nanophosphors.

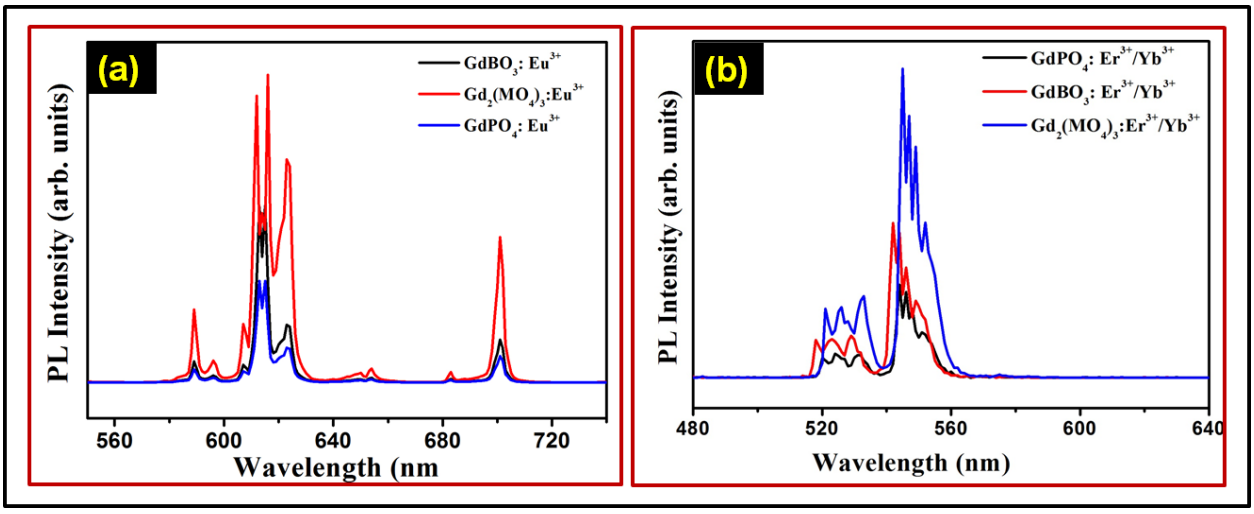

Fig. S12: (a) emission spectra of $Gd_2(MO_4)_3:Eu^{3+}$, $GdPO_4$: Eu^{3+} and $GdBO_3$: Eu^{3+} downshift nanophosphors at excitation wavelength 395 nm and (b) emission spectra of $Gd_2(MO_4)_3:Er^{3+}/Yb^{3+}$, $GdPO_4$: Er^{3+}/Yb^{3+} and $GdBO_3$: Er^{3+}/Yb^{3+} upconversion nanophosphors at excitation wavelength 980 nm.

$Gd_{2-x}(MoO_4)_3:Eu_x^{3+}$ x = (0.1 to 0.5)	Lattice Parameter a (Å)	Lattice Parameter b (Å)	Lattice Parameter c (Å)	Cell Volume $(Å)^3$
JCPDS Standard card no.20-0408	10.38	10.41	10.69	1155.1195
$Gd_{1.9}(MoO_4)_3:Eu_{0.1}^{3+}$	10.2131 ± 0.0019	10.1143 ± 0.0041	10.632 ± 0.0053	1098.2681 ± 0.4129 x 10^{-7}
$Gd_{1.8}(MoO_4)_3:Eu_{0.2}^{3+}$	10.1631 ± 0.0054	10.1132 ± 0.0021	10.740 ± 0.0027	1103.873 ± 0.3062 x 10^{-7}
$Gd_{1.7}(MoO_4)_3:Eu_{0.3}^{3+}$	10. 1532± 0.0032	10.0921 ± 0.0024	10.701 ± 0.0028	1096.5005 ± 0.2150 x 10^{-7}
$Gd_{1.6}(MoO_4)_3:Eu_{0.4}^{3+}$	10. 1326 ± 0.0026	10.0824 ± 0.0017	10.643± 0.0032	1087.4712 ± 0.1414 x 10^{-7}
$Gd_{1.5}(MoO_4)_3:Eu_{0.5}^{3+}$	10. 0982 ± 0.0023	10.0745 ± 0.0029	10.598 ± 0.0035	10 78.1803 ± 0.2334 x 10^{-7}

Table S1: Least squares refined unit cell parameters and cell volume for variants of $Gd_{2-x}(MoO_4)_3:Eu_x^{3+}$ downshift nanophosphor (x = 0.1 to 0.5).