

# Mo doped cerium gadolinium oxide as environmentally sustainable yellow pigments

*Sri Parasara Radhika, Kalarical Janardhanan Sreeram\*, Balachandran Unni Nair*

Chemical Laboratory, Central Leather Research Institute, Council of Scientific and  
Industrial Research, Adyar, Chennai 600 020 INDIA

**Total Pages: 7**

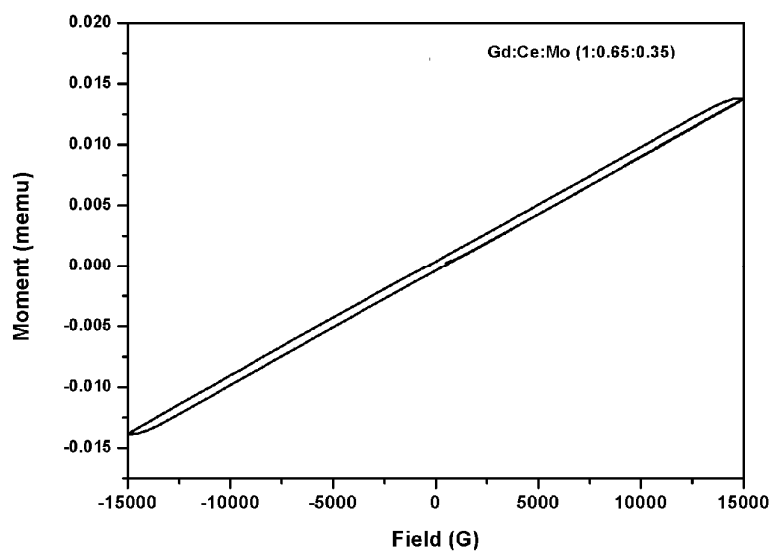
**No. of Supplementary Figures: 5**

**No. of Supplementary Tables: 1**

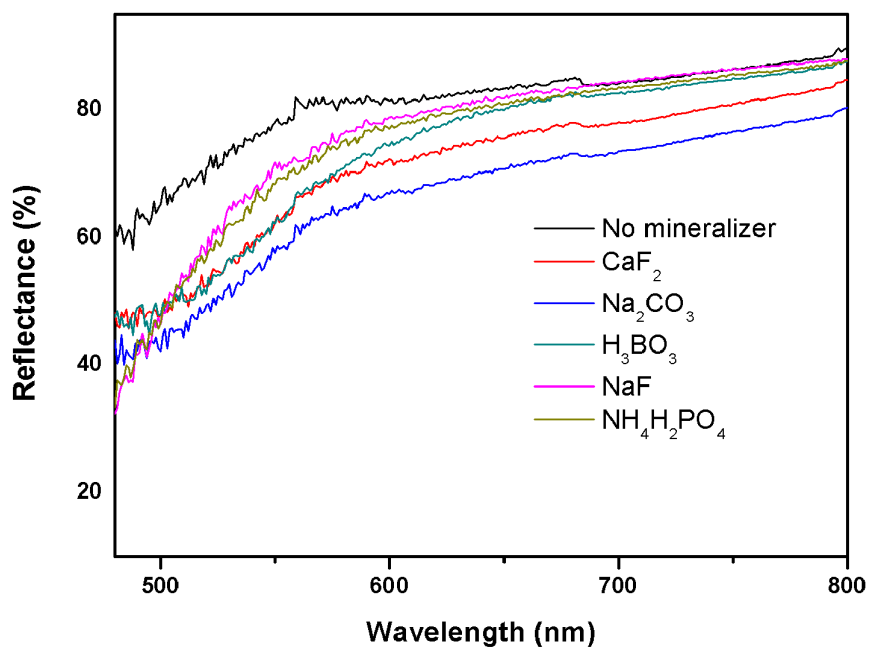
**Supplementary Figure S1.** Photographs of oxides of Gd-Ce-Mo, synthesized from nitrate salts of gadolinium, cerium and ammonium salt of molybdenum through a sol-gel-calcination route (gelation at 100°C; calcination at 800°C/2h). In the figure, the  $a^*$  values have been plotted against corresponding  $b^*$  values on left axis and L values on right axis for starting metal ion ratio of Gd:Ce:Mo have been taken into consideration. a) 1:1:0; b) 1:0.95:0.05; c) 1:0.9:0.1; d) 1:0.85:0.15; e) 1:0.8:0.20; f) 1:0.75:0.25; g) 1:0.65:0.35.



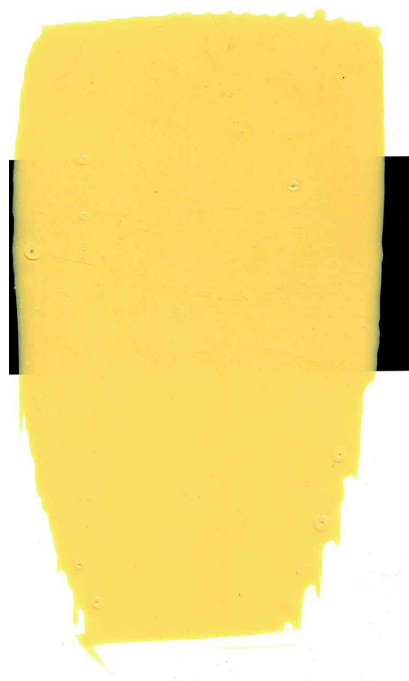
**Supplementary Figure S2.** Magnetic hysteresis loop for oxide of Gd-Ce-Mo, synthesized from nitrate salts of gadolinium, cerium and ammonium salt of molybdenum (1:0.65:0.35) through a sol-gel-calcination route (gelation at 100°C; calcination at 800°C/2h).



**Supplementary Figure S3.** Reflectance spectra for oxides of Gd-Ce-Mo, synthesized from nitrate salts of gadolinium, cerium and ammonium salt of molybdenum (1:0.65:0.35) through a sol-gel-calcination route (gelation at 100°C; calcination at 800°C/2h). In the figure, the spectra for oxide without mineralizer addition has been compared against those of  $\text{CaF}_2$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{H}_3\text{BO}_3$ ,  $\text{NaF}$ ,  $\text{NH}_4\text{H}_2\text{PO}_4$ .



**Supplementary Figure S4.** Coating of oxide of Gd-Ce-Mo, synthesized from nitrate salts of gadolinium, cerium and ammonium salt of molybdenum (1:0.65:0.35) through a sol-gel-calcination route (gelation at 100°C; calcination at 800°C/2h), after dispersing in a standard alkyd resin. The photograph clearly indicates the covering of both white and black regions, resembling clean and dirty surfaces. In the accompanying table, the CIELAB color coordinates and the color difference calculated from the difference in color coordinates of white and black is presented.



Color coordinates	Gd: Ce: Mo (1:1:0)		Gd: Ce: Mo (1:0.65:0.35)	
	On white	On Black	On White	On Black
L	69.5	60.3	71.4	70.4
a*	2.2	-2.6	7.6	4.1
b*	20	18.9	37.7	34.6
h°	84.4	97.9	78.6	83.1
C	18	19	38.4	34.9

**Supplementary Figure S5.** Photograph of the plastic disc after incorporation of oxide of Gd-Ce-Mo, synthesized from nitrate salts of gadolinium, cerium and ammonium salt of molybdenum (1:0.65:0.35) through a sol-gel-calcination route (gelation at 100°C; calcination at 800°C/2h), into PMMA. The photograph clearly indicates a good color.



**Supplementary Table S1.** The CIELAB color coordinates of four different spots in the plastic disc colored using Gd-Ce-Mo (1:0.65:0.35) pigment.

Composition (Gd: Ce: Mo ) [1:0.65:0.35]	Color Coordinates				
	L*	a*	b*	$h^o$	c
Surface1	74.90	5.465	36.38	81.42	36.79
Surface2	74.93	5.735	36.30	80.99	36.30
Surface3	75.34	5.596	36.72	81.30	36.72
Surface 4	75.17	5.663	36.67	81.18	36.67