Grossmanite $Ca(Ti^{3+}, Mg, Ti^{4+})AlSiO_6$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. Coating spinel grains as irregular masses 1-7 μm. *Twinning*: None observed.

Physical Properties: *Cleavage*: n.d. *Tenacity*: n.d. *Fracture*: n.d. Hardness = n.d. D(meas.) = n.d. D(calc.) = 3.41

Optical Properties: Transparent. *Color*: Light gray in thin-section. *Streak*: n.d. *Luster*: n.d. *Optical Class*: [Biaxial]. n.d.

Cell Data: *Space Group*: *C*2/*c*. a = 9.80 b = 8.85 c = 5.36 β = 105.62° Z = 4

X-ray Powder Pattern: Allende meteorite.
2.996 (100), 2.535 (47), 2.581 (42), 2.964 (31), 2.600 (28), 2.909 (25) 2.130 (19)

Chemistry:

	(1)	(2)
SiO_2	27.99	25.14
Al_2O_3	24.71	21.33
CaO	24.58	23.46
Ti_2O_3	10.91	30.08
TiO_2	6.68	
MgO	4.45	
Sc_2O_3	0.43	
V_2O_3	0.19	
ZrO_2	0.13	
FeO	0.08	
Cr_2O_3	0.03	.
Total	100.20	100.01

(1) Allende meteorite; average electron microprobe analysis supplemented by Raman spectroscopy, total Ti as 18.80 wt% TiO_2 was partitioned between Ti^{3+} and Ti^{4+} to make ideal stoichiometry; corresponds to $Ca_{1.00}[(Ti^{3+}_{0.35}Al_{0.18}Sc_{0.01}V^{3+}_{0.01})_{\Sigma=0.55}Mg_{0.25}Ti^{4+}_{0.19}]_{\Sigma=1.00}(Si_{1.07}Al_{0.93})_{\Sigma=2.00}O_6$.
(2) $CaTi^{3+}AlSiO_6$.

Mineral Group: Clinopyroxene group.

Occurrence: Likely formed through high-temperature condensation in the solar nebula, followed by melting and crystallization in Ca-,Al-rich refractory inclusions in a meteorite.

Association: Spinel, perovskite, grossite, melilite.

Distribution: In the Allende meteorite.

Name: Honors Lawrence *Grossman* (b. 1946), Professor of Cosmochemistry, University of Chicago, USA, for his fundamental contributions to meteorite research.

Type Material: National Museum of Natural History, Washington D.C., USA (USNM 7562).

References: (1) Ma, C. and G.R. Rossman (2009) Grossmanite, $CaTi^{3+}AlSiO_6$, a new pyroxene from the Allende meteorite. Amer. Mineral., 94, 1491-1494.