

**Grossmanite****Ca(Ti<sup>3+</sup>, Mg, Ti<sup>4+</sup>)AlSiO<sub>6</sub>**

**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:* C2/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)

<b>Chemistry:</b>	(1)	(2)
SiO <sub>2</sub>	27.99	25.14
Al <sub>2</sub> O <sub>3</sub>	24.71	21.33
CaO	24.58	23.46
Ti <sub>2</sub> O <sub>3</sub>	10.91	30.08
TiO <sub>2</sub>	6.68	
MgO	4.45	
Sc <sub>2</sub> O <sub>3</sub>	0.43	
V <sub>2</sub> O <sub>3</sub>	0.19	
ZrO <sub>2</sub>	0.13	
FeO	0.08	
<u>Cr<sub>2</sub>O<sub>3</sub></u>	<u>0.03</u>	
Total	100.20	100.01

(1) Allende meteorite; average electron microprobe analysis supplemented by Raman spectroscopy, total Ti as 18.80 wt% TiO<sub>2</sub> was partitioned between Ti<sup>3+</sup> and Ti<sup>4+</sup> to make ideal stoichiometry; corresponds to Ca<sub>1.00</sub>[(Ti<sup>3+</sup><sub>0.35</sub>Al<sub>0.18</sub>Sc<sub>0.01</sub>V<sup>3+</sup><sub>0.01</sub>)<sub>Σ=0.55</sub>Mg<sub>0.25</sub>Ti<sup>4+</sup><sub>0.19</sub>]<sub>Σ=1.00</sub>(Si<sub>1.07</sub>Al<sub>0.93</sub>)<sub>Σ=2.00</sub>O<sub>6</sub>.

(2) CaTi<sup>3+</sup>AlSiO<sub>6</sub>.

**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<sup>3+</sup>AlSiO<sub>6</sub>, a new pyroxene from the Allende meteorite. *Amer. Mineral.*, 94, 1491-1494.