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THEORETICAL DENSITY OF LITHIUM ALUMINATE UPDATED

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THEORETICAL DENSITY OF LITHIUM ALUMINATE UPDATED

W. E. Gurwell
Fabrication Development

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The "handbook" density for LiAlO_2 is 2.55 gms/cc. Recent data^{1,2,3} show that it should be revised to 2.62 gms/cc. In the future densities reported as per cent of theoretical should be based on 2.62 gm/cc as being 100%. Values quoted on this basis will be more realistic.

In order to avoid confusion it will be necessary to state which number per cent of theoretical density are based upon--that is, "2.62 gms/cc=100%," or "2.55 gms/cc=100%."

For the convenience of those working directly with the material, a conversion chart is given in Table I. Table II gives density (gm/cc) versus per cent density based on 2.62 gm/cc.

Technical Basis

¹
Marezio recently studied the structure of $\gamma\text{-LiAlO}_2$ single crystals grown from a molten salt bath. From his X-ray diffraction data he calculated the theoretical density of $\gamma\text{-LiAlO}_2$ to be 2.615 gms/cc.

²
Lehmann and Hesselbarth measured the density of carefully prepared $\gamma\text{-LiAlO}_2$ by means of a pycnometer and found it to be 2.61 gms/cc.

³
Density measurements obtained from mercury porosimeter data have been consistently in the range 2.60 to 2.65 gms/cc.

The primary source of the 2.55 gms/cc density for $\gamma\text{-LiAlO}_2$ is unknown to us at this time.

²
 $\alpha\text{-LiAlO}_2$ has a density of 3.38 gm/cc. However, it slowly, and irreversibly transforms to $\gamma\text{-LiAlO}_2$ above 600°C. Specimens of pure $\alpha\text{-LiAlO}_2$ are difficult to prepare, and thus rarely found. It is more usual to find a

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a mixture of the two crystalline phases. Pure γ -LiAlO₂ may be prepared from these mixtures by heating above 1000°C for a few hours.

REFERENCES

1. Marezio, M., Acta Cryst. (1965). 19, 396.
2. Lehmann, H. A., and Hesselbarth, H., Z.Anorg. Allgem. Chemie 313, 117 (1961).
3. Unpublished data, BNW, Materials and Metallurgy Departments.

TABLE I.

<u>Density-gm/cc</u>	<u>% Theoretical Density</u>	
	<u>2.62=100%</u>	<u>2.55=100%</u>
2.62	100.0	102.7
2.55	97.3	100.0
2.49	95.0	97.6
2.42	92.4	95.0
2.36	90.0	92.5
2.30	87.8	90.0
2.23	85.0	87.4
2.17	82.8	85.0
2.10	80.0	82.4
2.04	77.9	80.0
1.97	75.0	77.3
1.91	72.9	75.0
1.83	70.0	71.8
1.79	68.3	70.0
1.70	65.0	66.7
1.66	63.4	65.0
1.57	60.0	61.6
1.53	58.4	60.0
1.44	55.0	56.5
1.40	53.4	55.0
1.31	50.0	51.4
1.28	48.9	50.0

TABLE II.

DENSITY VS. % THEORETICAL DENSITY FOR γ -LiAlO₂

<u>Density</u>	<u>% Density</u>	<u>Density</u>	<u>% Density</u>
2.62	100.0	2.19	83.6
2.61	99.6	2.18	83.2
2.60	99.2	2.17	82.8
		2.16	82.4
2.59	98.9	2.15	82.1
2.58	98.5	2.14	81.7
2.57	98.1	2.13	81.3
2.56	97.7	2.12	80.9
2.55	97.3	2.11	80.5
2.54	96.9	2.10	80.2
2.53	96.6		
2.52	96.2	2.09	79.8
2.51	95.8	2.08	79.4
2.50	95.4	2.07	79.0
		2.06	78.6
2.49	95.0	2.05	78.2
2.48	94.7	2.04	77.9
2.47	94.3	2.03	77.5
2.46	93.9	2.02	77.1
2.45	93.5	2.01	76.7
2.44	93.1	2.00	76.3
2.43	92.7	1.99	76.0
2.42	92.4	1.98	75.6
2.41	92.0	1.97	75.2
2.40	91.6	1.96	74.8
		1.95	74.4
2.39	91.2	1.94	74.4
2.38	90.8	1.93	73.7
2.37	90.5	1.92	73.3
2.36	90.1	1.91	72.9
2.35	98.7	1.90	72.5
2.34	98.3		
2.33	88.9	1.89	72.1
2.32	88.5	1.88	71.8
2.31	88.2	1.87	71.4
2.30	87.8	1.86	71.0
		1.85	70.6
2.29	87.4	1.84	70.2
2.28	87.0	1.83	69.8
2.27	86.6	1.82	69.5
2.26	86.3	1.81	69.1
2.25	85.9	1.80	68.7
2.24	85.5		
2.23	85.1	1.79	68.3
2.22	84.7	1.78	67.9
2.21	84.3	1.77	67.6
2.20	84.0	1.76	67.2

TABLE II. (Continued)

<u>Density</u>	<u>% Density</u>	<u>Density</u>	<u>% Density</u>
1.75	66.8	1.53	58.4
1.74	66.4	1.52	58.0
1.73	66.0	1.51	57.6
1.71	65.3	1.50	57.3
1.70	64.9		
		1.40	53.4
1.69	64.5	1.30	49.6
1.68	64.1	1.20	45.8
1.67	63.7	1.10	42.0
1.66	63.4	1.00	38.2
1.65	63.0	0.90	34.4
1.64	62.6	0.80	30.5
1.63	62.2	0.70	26.7
1.62	61.8	0.60	22.9
1.61	61.4	0.50	19.1
1.60	61.1	0.40	15.3
		0.30	11.5
1.59	60.7	0.20	7.6
1.58	60.3	0.10	3.8
1.57	59.9	0.00	0.0
1.56	59.9		
1.55	59.2		
1.54	58.8		

Interpolation:

Each 0.01 gm/cc change in density equals 0.38% density change. To convert 4 place density figures use the following interpolation guide.

4th DigitAdd to %Density for the first three places

9	.4
8	.3
7	.3
6	.2
5	.2
4	.2
3	.1
2	.1
1	0

Example:

1.680 gms/cc=64.1% density. Then 1.686 gms/cc=64.1 + .2=64.3% density.