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Technical Note

Crystallographic Angles for Tin

by J. F. Nicholas

THE angles between the crystallographic planes in cubic metals were originally given by Bozorth¹ and have been republished many times. Recently, Salkovitz² tabulated the angles for the hexagonal metals (magnesium, zinc, and cadmium). The most commonly used metal which does not fall into either of these groups is tin, which has a tetragonal structure with an axial ratio of $c/a = 0.54558$ (99.99 pct purity, 25°C).³ Accordingly, Table I has been prepared giving the possible values for the angle, ϕ , between planes of the types $\{HKL\}$ and $\{hkl\}$. The formula used was:

$$\cos \phi = \frac{Hh + Kk + Ll \frac{a^2}{c^2}}{\left[\left(H^2 + K^2 + L^2 \frac{a^2}{c^2} \right) \left(h^2 + k^2 + l^2 \frac{a^2}{c^2} \right) \right]^{1/2}}$$

All angles are given correct to the nearest minute as this is sufficient for all practical purposes. Every angle depends in a different way on variations in the value of c/a , but even in the worst cases a variation of about 0.0003 in this ratio is needed to vary an angle by 1', which corresponds to a temperature change of 20°C or can be caused by impurities.

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J. F. NICHOLAS is Research Officer, Div. of Tribophysics, Commonwealth Scientific and Industrial Research Organization, University of Melbourne, Carlton, Vic., Australia.

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Table I. Angles between the Crystallographic Planes in Tetragonal Tin

Angles between Planes of Types {HKL} {hkl}			Angles between Planes of Types {HKL} {hkl}		
{HKL}	{hkl}	{HKL} and {hkl}	{HKL}	{hkl}	{HKL} and {hkl}
001	100	90°	111	111	0°
	101	28° 37'		112	16° 33'
	110	90°		211	18° 11'
	111	37° 39'			49° 22'
	112	21° 6'			69° 22'
	211	50° 40'		301	86° 55'
	301	58° 35'			87° 28'
	113	14° 25'		113	23° 14'
100	311	59° 54'		311	39° 56'
					52° 5'
					80° 45'
	100	0°	112	112	0°
	101	61° 23'		211	31° 11'
	110	45°			29° 29'
	111	64° 24'			42° 11'
	112	75° 15'		301	70° 53'
	211	46° 14'			49° 22'
	301	31° 25'		113	45° 17'
	113	79° 51'			74° 23'
101	311	34° 50'		311	6° 40'
					25° 22'
					35° 31'
	101	0°	211	211	0°
	110	57° 14'			28° 19'
	111	70° 12'			40° 28'
	112	25° 36'			66° 18'
	113	19° 48'			78° 41'
	211	27° 24'			85° 36'
		67° 0'		301	87° 32'
	301	29° 58'			51° 16'
110	110	0°		113	37° 11'
	111	52° 21'			47° 33'
	112	68° 54'		311	64° 27'
	211	42° 48'			37° 43'
	301	52° 53'			65° 38'
	113	75° 35'	301	301	0°
	311	39° 18'			62° 51'
				113	49° 4'
					69° 14'
				311	15° 53'
					60° 20'
					63° 58'
					88° 24'
311	110	0°	113	113	0°
	111	52° 21'			20° 17'
	112	68° 54'		311	47° 17'
	211	42° 48'			54° 24'
	301	52° 53'			28° 51'
	113	75° 35'			67° 5'
	311	39° 18'			
			311	311	0°
					31° 45'
					45° 32'
					60° 12'
					69° 41'
					75° 26'
					78° 36'