

# National Bureau of Standards

## Certificate

### Standard Reference Material 675

#### Low $2\theta$ (Large d-Spacing) Standard

#### for X-Ray Powder Diffraction

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This Standard Reference Material (SRM) was prepared for use as an external or internal low  $2\theta$  (large d-spacing) calibration standard for powder diffractometry. The material is synthetic fluorophlogopite mica and is best suited for reflection diffractometry as pressed samples have a high degree of preferred orientation in which only the 00 $l$  reflections have significant intensity. The mica was ground to pass a 75- $\mu\text{m}$  (200 mesh) sieve.

A total of 28 samples, mixed with silicon [1] and tungsten [2] internal standards, were measured using a high angle goniometer controlled by a minicomputer. For each sample, the peak positions of eighteen internal standard and eleven 00 $l$  fluorophlogopite reflections were determined by profile fitting procedures and corrected for the effects of thermal expansion. The fluorophlogopite reflections were then corrected for instrumental and physical aberrations (except refraction) through use of the internal standard lines [3].

Each corrected set was refined by a least-square routine that minimized  $\sum (\theta_{\text{obs}} - \theta_{\text{calc}})^2$  to obtain estimates of  $d(001)$  and a transparency-displacement parameter. The certified value, based on the average of the 28 refined  $d$  values at 25.0 °C and uncorrected for refraction, is

$$d(001) = 9.98104 \pm 0.00007 \text{ \AA}$$

where  $\lambda(\text{CuK}\alpha_1) = 1.5405981 \text{ \AA}$  [4]. The estimated uncertainty given above is dominated by the random errors in measurement. Without correction for the transparency-displacement effect [3], the  $2\theta$  angles for the 001 and 003 reflections for  $\text{CuK}\alpha$  x rays should be accurate to better than  $0.01^\circ 2\theta$  for a highly absorbing sample. For a sample with absorption similar to that of fluorophlogopite, these lines will be accurate to nearly  $0.001^\circ 2\theta$ .

The technical and support aspects concerning the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R.K. Kirby.

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The  $2\theta$  values given in Table 1 were calculated from the certified value of  $d(001)$ . The approximate peak height relative intensities,  $I(\text{rel})$ , measured using  $\theta$ -compensating slits, are also given in Table 1. They can be used as an aid in identifying the fluorophlogopite lines when SRM 675 is mixed with other phases. The uncertainty in  $I(\text{rel})$  is approximately  $\pm 1$  in the least significant digit except for the 001 line. For this low angle line, the uncertainty is  $\pm 5$ . These intensities, converted to an approximately fixed sample volume basis by applying a  $1/\sin\theta$  factor, are given in the last column. These intensities were reproducible to  $\pm 1$  in the least significant digit except for the 001 reflection for which the uncertainty is approximately  $\pm 15$ .

Table 1  
 Diffraction Angles and Relative Intensities  
 $[\lambda(\text{CuK}\alpha_1) = 1.5405981 \text{ \AA}, T = 25.0 \text{ }^\circ\text{C}]$

$h^+$	$2\theta_{\text{peak}}$	$I(\text{rel})$	
		$\theta$ --Comp Slits	Fixed Volume
1	8.853°	27	81
2	17.759	3.2	4.8
3	26.774	100	100
4	35.962	9	6.8
5	45.397	46	28
6	55.169	3.2	1.6
7	65.399	4.6	2.0
8	76.255	5.4	2.0
10	101.025	1.7	0.5
11	116.193	1.8	0.5
12	135.674	0.5	0.1

\*The 009 reflection is omitted as its intensity is very low.

#### References

- [1] C. R. Hubbard (1982) "Certification of Si Powder Diffraction Standard Reference Material 640a", J. Appl Cryst., to be published.
- [2] H. E. Swanson, H. F. McMurdie, M. C. Morris, and E. H. Evans (1966) NBS Monograph 25, Sec. 4, pp. 3-4.
- [3] C. R. Hubbard (1982) "Fluorophlogopite--Low  $2\theta$  Large d-Spacing Powder Diffraction Standard Reference Material 675", submitted to J. Appl. Cryst.
- [4] R. Deslattes and A. Hening (1973) Phy. Rev. Lett., 31, 972.