Crookesite $Cu_7(Tl, Ag)Se_4$

Crystal Data: Tetragonal. *Point Group:* $4/m$, 4, or $\overline{4}$. As finely divided, disseminated specks, and as small veinlets.

Physical Properties: *Cleavage:* Two at right angles, fairly well developed. *Tenacity:* Brittle. Hardness = 2.5–3 VHN = 92–123 (100 g load). D(meas.) = 6.90 D(calc.) = 7.443

Optical Properties: Opaque. *Color:* Lead-gray. *Luster:* Metallic. *Anisotropism:* Weak but distinct, in brownish tones.

R_1–R_2: (400) 33.6–35.9, (420) 33.3–35.8, (440) 32.7–35.8, (460) 32.4–35.7, (480) 32.5–35.6, (500) 32.8–35.3, (520) 33.1–35.1, (540) 33.1–34.8, (560) 33.0–34.7, (580) 32.7–34.6, (600) 32.6–34.7, (620) 32.4–35.0, (640) 32.2–35.2, (660) 31.9–35.2, (680) 31.6–35.3, (700) 31.2–35.3

Cell Data: *Space Group:* $I4/m$, $I4$, or $I\overline{4}$. $a = 10.435$ $c = 3.954$ $Z = 2$

X-ray Powder Pattern: Skrikerum, Sweden.
3.29 (100), 2.59 (100), 3.00 (80), 2.11 (50), 1.833 (40), 1.779 (40), 2.32 (30)

Chemistry:

	(1)	(2)	(3)	(5)
Tl	16.27	18.55	21.03	21.18
Cu	46.55	46.11	46.89	46.09
Ag	5.04	1.44	0.06	
Fe	0.36	0.63		
Se	30.86	33.27	32.43	32.73
Total	99.08	100.00	100.41	100.00

(1) Skrikerum, Sweden; corresponds to $Cu_{7.50}Tl_{0.82}Ag_{0.48}Fe_{0.07}Se_{4.00}$. (2) Do.; corresponds to $Cu_{6.89}Tl_{0.86}Ag_{0.13}Fe_{0.11}Se_{4.00}$. (3) Bukov, Czech Republic; by electron microprobe, leading to $Cu_{7.07}Tl_{0.98}Ag_{0.01}Se_{3.94}$. (4) Tuminico, Argentina; by electron microprobe, analysis not given, corresponds to $Cu_{7.00}Tl_{0.97}Se_{4.04}$. (5) Cu_7TlSe_4.

Occurrence: Of hydrothermal origin, with other selenides.

Association: Umangite, berzelianite, eucairite, klockmannite, clausthalite, sabatierite, selenian linnaeite, calcite, quartz.

Distribution: From Skrikerum, near Tryserum, Kalmar, Sweden [TL]. At Tilkerode, Harz Mountains, Germany. From Bukov, near Tisnova, and in the Petrovice uranium deposit, near Ždár, Czech Republic. In the Pinky Fault uranium deposit, near Lake Athabasca, Saskatchewan, Canada. At Tuminico, Sierra de Cacho, La Rioja Province, Argentina.

Name: In honor of William Crookes (1832–1919), English chemist who discovered thallium.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 183. (2) Earley, J.W. (1950) Description and synthesis of the selenide minerals. Amer. Mineral., 35, 337–364. (3) Ramdohr, P. (1969) The ore minerals and their intergrowths, (3rd edition), 50–51. (4) Johan, Z. (1987) Crookesite, $TlCu_7Se_4$; new data and isotypism with $NH_4Cu_7S_4$. Compt. Rendus Acad. Sci. Paris, 304, 1121–1124 (in French). (5) Berger, R.A. (1987) Crookesite and sabatierite in a new light — a crystallographer's comment. Zeits. Krist., 181, 241–249. (6) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 120.