

**Crystal Data:** Cubic. *Point Group:*  $4/m\bar{3}2/m$ . Crystals are dominantly octahedral, to 1 cm; also massive, granular to compact. *Twinning:* On {111}.

**Physical Properties:** *Cleavage:* Imperfect on {001}; reported on {111}.  
*Fracture:* Subconchoidal to uneven. Hardness = 4.5–5.5 VHN = 379–427 (100 g load).  
 D(meas.) = 4.5–4.8 D(calc.) = 4.83

**Optical Properties:** Opaque. *Color:* Pale gray to steel-gray, tarnishing to copper-red.  
*Luster:* Metallic, brilliant on fresh surface.

R: (400) 44.3, (420) 44.8, (440) 45.3, (460) 45.7, (480) 46.0, (500) 46.2, (520) 46.2, (540) 46.0, (560) 45.8, (580) 45.8, (600) 46.2, (620) 46.9, (640) 48.0, (660) 49.6, (680) 51.2, (700) 53.0

**Cell Data:** *Space Group:*  $Fd\bar{3}m$ .  $a = 9.405$   $Z = 8$

**X-ray Powder Pattern:** Siegen, Germany.  
 2.87 (100), 1.678 (80), 2.37 (60), 1.825 (50), 0.994 (50), 1.060 (40), 3.36 (30)

Chemistry:	(1)	(2)	(3)
Ni	54.30	55.2	57.86
Fe	3.98	3.1	
Co	0.63	0.8	
S	41.09	41.2	42.14
Total	[100.00]	100.3	100.00

(1) Grünau mine, Germany; recalculated to 100% after deducting gersdorffite and ullmannite 5%; then corresponds to  $(\text{Ni}_{2.83}\text{Fe}_{0.22}\text{Co}_{0.03})_{\Sigma=3.08}\text{S}_{3.92}$ . (2) Madziwa mine, Zimbabwe; by electron microprobe, corresponds to  $(\text{Ni}_{2.87}\text{Fe}_{0.17}\text{Co}_{0.04})_{\Sigma=3.08}\text{S}_{3.92}$ . (3) Ni<sub>3</sub>S<sub>4</sub>.

**Polymorphism & Series:** Forms a series with linnaeite.

**Mineral Group:** Linnaeite group.

**Occurrence:** In hydrothermal veins.

**Association:** Chalcopyrite, pyrrhotite, pyrite, millerite, gersdorffite, ullmannite, sphalerite, galena, bismuthinite, quartz, siderite.

**Distribution:** In Germany, in the Grünau mine, Daaden, near Siegen [TL], and at Ramsbeck, North Rhine-Westphalia. From Saint Marina, Khaskovo district, Bulgaria. At Kunratice and Rozany, Czech Republic. From Novo-Aidyrlinsk, Southern Ural Mountains, and the Noril'sk region, western Siberia, Russia. In the USA, from Hamilton, Hancock Co., Illinois; in the Miliken (Sweetwater) mine, Reynolds Co., Missouri; and at the Copper King mine, Gold Hill district, Boulder Co., Colorado. In the Madziwa (Dry Nickel) mine, Bindura; and at Shamva, Zimbabwe. Large crystals from Shinkolobwe, Katanga Province, Congo (Shaba Province, Zaire). At Jabal Mardah, Saudi Arabia. From Kalgoorlie, Western Australia.

**Name:** From the Greek for *many* and *twinned*, as the mineral is observed in twinned forms.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 262–265. (2) Vaughan, D.J. and J.R. Craig (1985) The crystal chemistry of iron-nickel thiospinels. *Amer. Mineral.*, 70, 1036–1043. (3) Berry, L.G. and R.M. Thompson (1962) X-ray powder data for the ore minerals. *Geol. Soc. Amer. Mem.* 85, 78. (4) Ramdohr, P. (1969) The ore minerals and their intergrowths, (3rd edition), 686–691. (5) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 448.

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