



>>Entry Name: Ruthenium(IV) oxide (RuO₂)

Synonym(s): Ruthenium dioxide

CAS Registry Number: 12036-10-1

RuO₂

Molecular Formula: O₂Ru

Molecular Weight: 133.069

Accurate Mass: 133.894178

Percentage Composition: O 24.05%; Ru 75.95%

coord. with six oxygens at 198.9 pm, and two more at 295.5 pm: intrapolyhedral O...O 262.1 pm: interpolyhedral O...O 250.5 pm (minimum), where latter are shortest known in any solid

Source/Synthesis: Prepared by direct combination, oxidation of RuCl₃·xH₂O or RuCl₃, or thermal dehydration of hydrated oxide

Use/Importance: Used for the formation of dimensionally stable anodes (Ti metal coated with RuO₂/TiO₂) for the chlor-alkali industry. Shows electrochromic props.

Physical Description: Blue-black tetragonal cryst.; grown by chemical vapour transport in O₂. Crysts. show metallic conductivity and Pauli paramagnetism

Other Data: $\Delta H_f^\circ -302 \text{ kJ mol}^{-1}$; $\Delta S_f^\circ -181 \text{ J K}^{-1} \text{ mol}^{-1}$. Cubic (high-pressure) phase has very low compressibility bulk modulus, 399 GPa is close to that of diamond (422 GPa), hardest known material

Aldrich: 23805-8

Fluka: 84060

>>Derivative: Hydrate

Source/Synthesis: Obt. in catalytically active form by reducing RuO₄ in H₂O/H₂

Use/Importance: Active catalyst and extremely useful synthetic reagent

Other Data: Degree of hydration is variable, max. dihydrate. Heating → anhyd. form results in loss of catalytic activity

References:

- Keattch, C.J. *et al.*, *J. Less-Common Met.*, 1962, **4**, 460, (*rev, hydrate*)
Bell, W.E. *et al.*, *J. Phys. Chem.*, 1963, **67**, 2432, (*synth, thermodyn*)
Goodenough, J.B., *Bull. Soc. Chim. Fr.*, 1965, 1200, (*bonding*)
Cotton, F.A. *et al.*, *Inorg. Chem.*, 1966, **5**, 317, (*cryst struct*)
Fletcher, J.M. *et al.*, *J.C.S.(A)*, 1968, 653, (*synth, conductivity, use, magnetism, cryst struct, hydrate*)
Rogers, D.B. *et al.*, *Inorg. Chem.*, 1969, **8**, 841, (*synth, conductivity, magnetism, bonding, cryst struct*)
Ryden, W.D. *et al.*, *Phys. Rev. B*, 1970, **1**, 1494, (*conductivity, bonding*)
Potzel, W. *et al.*, *Z. Phys.*, 1971, **241**, 179, (*Mössbauer*)
Inorg. Synth., 1972, **13**, 135, (*single crystal growth*)
Brauer, G., *Handbuch Prap. Anorg. Chem.*, 3rd edn., Ferdinand Enke Verlag, 1975, **3**, 1750, (*synth*)
Burke, L.D. *et al.*, *J. Electroanal. Chem.*, 1979, **103**, 179, (*electrochem, electrochromism*)
Shafer, M.W. *et al.*, *J. Electrochem. Soc.*, 1979, **126**, 1625, (*electrochem*)
Beatham, N. *et al.*, *J. Electron Spectrosc. Relat. Phenom.*, 1979, **16**, 77, (*pe*)
Knifton, J.F., *J. Mol. Catal.*, 1981, **11**, 91, (*use, hydrate*)
Seddon, E.A. *et al.*, *The Chemistry of Ruthenium*, Elsevier, Amsterdam, 1984, 113; 1247, (*rev*)
Seddon, K.R., *Coord. Chem. Rev.*, 1985, **67**, 171, (*rev, uses*)
Appleby, D. *et al.*, *J.C.S. Dalton*, 1990, 1879, (*synth, hydrate*)
Haines, J. *et al.*, *Acta Cryst. B*, 1997, **53**, 880-884, (*cryst struct, nd*)
Haines, J. *et al.*, *J. Phys. Chem. Solids*, 1998, **59**, 239-243, (*theory, high-pressure phase, nd, struct, Raman*)
Lewis, R.J., *Sax's Dangerous Properties of Industrial Materials*, 8th edn., Van Nostrand Reinhold, 1992, RSF875