

# Gold(III) Oxide and Oxychloride

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Of all metals, gold shows the least tendency to form simple compounds with oxygen; anhydrous gold(III) oxide was until recently unknown. We have successfully prepared single crystals of gold(III) oxide and gold(III) oxychloride large enough to permit structure determination by X-ray crystallography.

Both preparations (1, 2) involve the heating in sealed quartz tubes of amorphous hydrated gold(III) oxide with perchloric acid and an alkali metal perchlorate — temperatures and pressures of the order of 250°C and 30 MPa are required. Small variations of reagent ratios, temperature and pressure result in different ratios of products and different crystal sizes.

X-ray diffraction data for both compounds have been collected on an automated diffractometer, and both structures have been elucidated (3, 4).

Gold(III) oxide exhibits the usual square planar co-ordination of the metal atom as shown here. The asymmetric unit (smallest unique group of atoms) consists of one gold and two oxygen atoms, one oxygen atom lying on a crystallographic two-fold axis. This oxygen atom (O2 in the diagram) is co-ordinated to two gold atoms, the other, O1, is co-ordinated to three gold atoms. This is reflected in the stronger (shorter) Au-O2 bond. A *trans* effect is observed, the Au-O1 bond *trans* to O2 being longest. The extended polymeric structure is best seen as a stereoview (3).

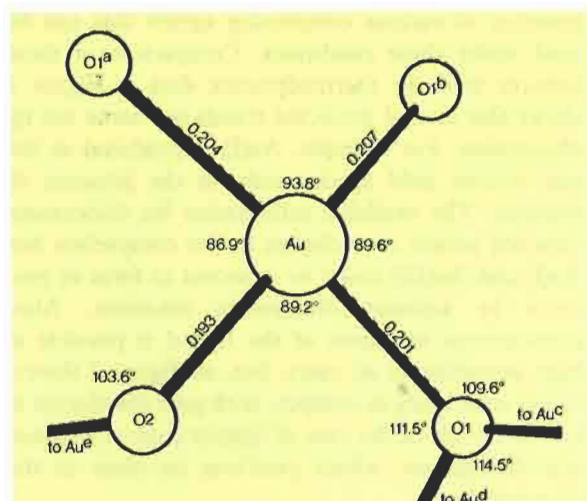
The structure of gold(III) oxychloride is also polymeric, with square planar co-ordination at the metal atom (by three oxygens and one chlorine); it also shows a *trans* effect, the AuO bond *trans* to Cl being longest.



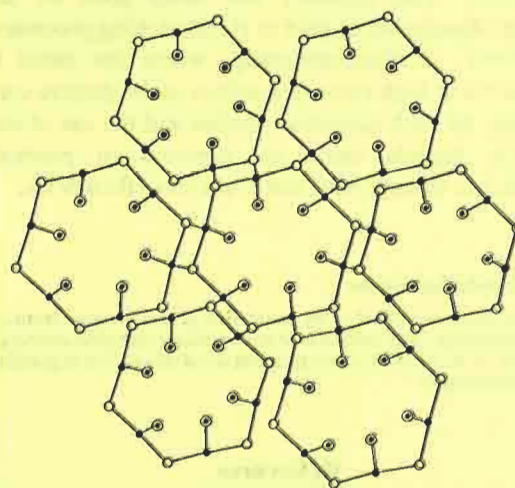
Crystals of  $\text{Au}_2\text{O}_3$  (maximum size 0.2 mm)

## References

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The square planar  $\text{AuO}_4$  unit in  $\text{Au}_2\text{O}_3$ , showing unique bond lengths in nm and angles in degrees. The superscripts refer to symmetry equivalent atoms



The extended structure of  $\text{AuOCl}$ . Oxygen, chlorine and gold atoms are represented by open, dotted and filled circles respectively. The structure consists of linked hexameric rings; the gold atoms lie in a plane with oxygen atoms 0.029 nm and chlorine atoms 0.193 nm alternatively above and below this plane