

= Zinc oxide =

Zinc oxide is an inorganic compound with the formula ZnO . ZnO is a white powder that is insoluble in water , and it is widely used as an additive in numerous materials and products including rubbers , plastics , ceramics , glass , cement , lubricants , paints , ointments , adhesives , sealants , pigments , foods , batteries , ferrites , fire retardants , and first @-@ aid tapes . Although it occurs naturally as the mineral zincite , most zinc oxide is produced synthetically .

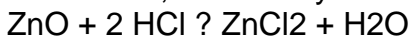
ZnO is a wide @-@ bandgap semiconductor of the II @-@ VI semiconductor group . The native doping of the semiconductor due to oxygen vacancies or zinc interstitials is n @-@ type . This semiconductor has several favorable properties , including good transparency , high electron mobility , wide bandgap , and strong room @-@ temperature luminescence . Those properties are valuable in emerging applications for : transparent electrodes in liquid crystal displays , energy @-@ saving or heat @-@ protecting windows , and electronics as thin @-@ film transistors and light @-@ emitting diodes .

= = Chemical properties = =

Pure ZnO is a white powder , but in nature it occurs as the rare mineral zincite , which usually contains manganese and other impurities that confer a yellow to red color .

Crystalline zinc oxide is thermochromic , changing from white to yellow when heated in air and reverting to white on cooling . This color change is caused by a small loss of oxygen to the environment at high temperatures to form the non @-@ stoichiometric  $Zn_{1-x}O$  , where at 800 ° C ,  $x = 0.00007$  .

Zinc oxide is an amphoteric oxide . It is nearly insoluble in water , but it is soluble in ( degraded by ) most acids , such as hydrochloric acid :



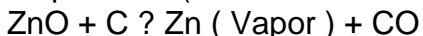
Bases also degrade the solid to give soluble zincates :



ZnO reacts slowly with fatty acids in oils to produce the corresponding carboxylates , such as oleate or stearate . ZnO forms cement @-@ like products when mixed with a strong aqueous solution of zinc chloride and these are best described as zinc hydroxy chlorides . This cement was used in dentistry .

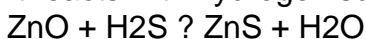
ZnO also forms cement @-@ like material when treated with phosphoric acid ; related materials are used in dentistry . A major component of zinc phosphate cement produced by this reaction is hopeite ,  $Zn_3 ( PO_4 )_2 \cdot 4H_2O$  .

ZnO decomposes into zinc vapor and oxygen at around 1975 ° C with a standard oxygen pressure . In a carbothermic reaction , heating with carbon converts the oxide into zinc vapor at a much lower temperature ( around 950 ° C ) .



Zinc oxide can react violently with aluminium and magnesium powders , with chlorinated rubber and linseed oil on heating causing fire and explosion hazard .

It reacts with hydrogen sulfide to give zinc sulfide . This reaction is used commercially .



= = Physical properties = =

= = = Structure = = =

Zinc oxide crystallizes in two main forms , hexagonal wurtzite and cubic zincblende . The wurtzite structure is most stable at ambient conditions and thus most common . The zincblende form can be stabilized by growing ZnO on substrates with cubic lattice structure . In both cases , the zinc and oxide centers are tetrahedral , the most characteristic geometry for Zn ( II ) . ZnO converts to the

rocksalt motif at relatively high pressures about 10 GPa .

Hexagonal and zincblende polymorphs have no inversion symmetry ( reflection of a crystal relative to any given point does not transform it into itself ) . This and other lattice symmetry properties result in piezoelectricity of the hexagonal and zincblende ZnO , and pyroelectricity of hexagonal ZnO .