Dinitrogen trioxide

Dinitrogen trioxide is the chemical compound with the formula N_2O_3. This deep blue solid[1] is one of the simple nitrogen oxides. It forms upon mixing equal parts of nitric oxide and nitrogen dioxide and cooling the mixture below −21 °C (−6 °F):[2]

Molar mass	76.01 g/mol
Appearance	deep blue tinted gas
Density	1.447 g/cm^3, liquid 1.783 g/cm^3 (gas)
Melting point	−100.7[1] °C (−149.3 °F; 172.5 K)
Boiling point	3.5 °C (38.3 °F; 276.6 K) (dissociates[1])
Solubility in water	very soluble
Solubility	soluble in ether
Magnetic susceptibility (χ)	$-16.0 \cdot 10^{-6}$ cm^3/mol

Structure	
Molecular shape	planar, C_s
Dipole moment	2.122 D
Thermochemistry	
Heat capacity (*C*)	65.3 J/mol K
Std molar entropy ($S^{\ominus}_{298}$)	314.63 $J\,K^{-1}\,mol^{-1}$
Std enthalpy of formation ($\Delta_f H^{\ominus}_{298}$)	+91.20 kJ/mol
Hazards	
EU classification (DSD) (*outdated*)	Highly toxic (**T+**)

✗ verify (what is ✓✗ ?)

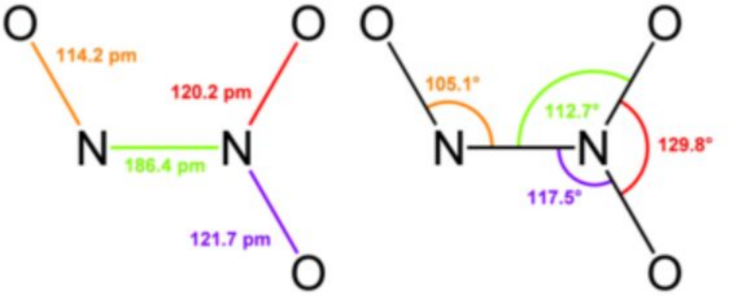
Infobox references

$$NO + NO_2 \rightleftharpoons N_2O_3$$

Dinitrogen trioxide is only isolable at low temperatures, i.e. in the liquid and solid phases. At higher temperatures the equilibrium favors the constituent gases, with K_{diss} = 193 kPa (25 °C).[3]

Structure and bonding

Typically, N–N bonds are similar in length to that in hydrazine (145 pm). Dinitrogen trioxide, however, has an unusually long N–N bond at 186 pm. Some other nitrogen oxides do also possess long N–N bonds, including dinitrogen tetroxide (175 pm). The N_2O_3 molecule is planar and exhibits Cs symmetry. The dimensions displayed below come from microwave spectroscopy of low-temperature, gaseous N_2O_3:[2]



It is the anhydride of the unstable nitrous acid (HNO_2), and produces it when mixed into water. An alternative structure might be anticipated for the true anhydride, i.e. O=N−O−N=O, but this isomer is not observed. If the nitrous acid is not then used up quickly, it decomposes into nitric oxide and nitric acid. Nitrite salts are sometimes produced by adding N_2O_3 to solutions of bases:

$$N_2O_3 + 2\ NaOH \rightarrow 2\ NaNO_2 + H_2O$$

References

Nitrogen sesquioxide N_2O_3

N_2O_3 can only be obtained at low temperatures. It can be made by condensing equimolar amounts of NO and NO_2 together, or by reacting NO with the appropriate amount of O_2. This gives a blue liquid or solid, which is unstable and dissociates into NO and NO_2 at −30°C.

$$NO + NO_2 \rightarrow N_2O_3$$

$$4NO + O_2 \rightarrow 2N_2O_3$$

It is an acidic oxide and is the anhydride of nitrous acid HNO_2. With alkali it forms nitrites.

$$N_2O_3 + H_2O \rightarrow 2HNO_2$$

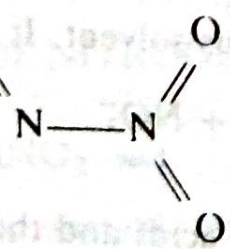
$$N_2O_3 + NaOH \rightarrow 2NaNO_2 + H_2O$$

N_2O_3 reacts with the concentrated acids, forming nitrosyl salts:

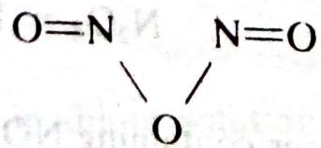
$$N_2O_3 + 2HClO_4 \rightarrow 2NO[ClO_4] + H_2O$$

$$N_2O_3 + 2H_2SO_4 \rightarrow 2NO[HSO_4] + H_2O$$

The oxide exists in two different forms. These may be interconverted by irradiation with light of the appropriate wavelength. The N—N bond length from microwave spectra is 1.864 Å in the asymmetrical form. This is exceptionally long and thus the bond is exceptionally weak compared with the N—N bond found in hydrazine (length of 1.45 Å).



asymmetrical form



symmetrical form
(has a two fold rotation axis)