Crystal structure determination of solid oxygen ε phase

Discovery of an O_8 cluster in a red solid state

A red form of solid oxygen (ε phase), formed under high pressure from 10 GPa to 96 GPa, was found in 1979. Despite many experimental and theoretical studies, the crystal structure of the ε phase has been unknown. We performed powder X-ray diffraction experiments and succeeded in analyzing its crystal structure. A unique O_8 cluster that consisted of 4 oxygen molecules was discovered in the structure.

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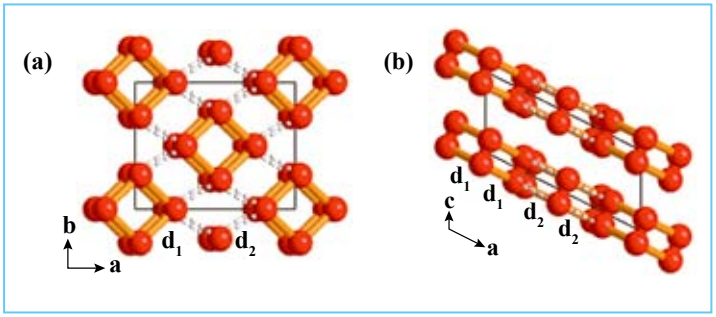

The crystal structure of oxygen ε phase at 11 GPa. (a) its projected figure to the *ab* plane, (b) its projected figure to the *ac* plane. *a*,*b*, and *c* denote crystallographic axes.The intra-molecular bond length of the oxygen molecule is 0.120 nm. The intra-cluster bond length of O_8 cluster (orange bar line d_1) is 0.234 nm, and the inter-cluster distance (dotted line d_2) is 0.266 nm.

Precise mass measurement of mass standards under vacuum condition

The amount of water molecules adsorbed on solid surfaces was determined in order to carry out precise mass measurement of mass standards under vacuum condition. The experimental data showed that the amount of the adsorption on a stainless steel surface was about 6 times larger than that on a single-crystal silicon surface treated with chemical mechanical polishing. This result can be interpreted as follows: the surface roughness and grain boundaries of the stainless steel surface influence the amount of adsorbed water.

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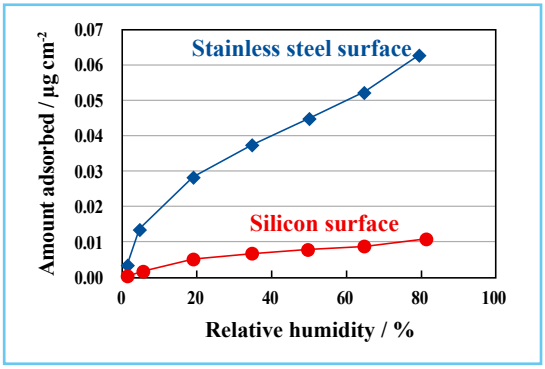

Adsorption isotherm of water vapour