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Uptake of excess oxygen by fully indium-exchanged zeolite Y to form cyclo-ozone rings and peroxides

Karl Seff
Chemistry Department, University of Hawaii, Honolulu HI 96822, USA

Abstract

Just as barium metal heated in air in the temperature range 300 to 500 ^{o}C forms barium peroxide, the In_5^{7+} ion (centered tetrahedral) in zeolite Y forms *cyclo*-ozone rings, one nestled in each of its 'faces,' upon heating in oxygen. Furthermore, each ring bonds to three other oxygen atoms to give *all cis*-1,2,3-trioxo-*cyclo*-ozone, which, via these three outermost oxygen atoms, binds covalently to oxide ions of the zeolite framework. Elsewhere in the crystal structure it is seen that some of the normal zeolite framework oxygen atoms have become peroxide ions, bridging between framework silicon and/or aluminum atoms in a *mu*-peroxo (sideways) manner. Additional indium peroxide structure is seen within the supercage. This material is stable at high temperatures – it is prepared at 350 ^{o}C and has survived evacuation at that temperature. Its structure was determined by single-crystal diffraction methods using synchrotron radiation, and is one of the most complex ever determined in this laboratory. Anhydrous fully In-exchanged zeolite Y, prepared by reacting fully Tl^{+}-exchanged zeolite Y with In metal at 350 ^{o}C, is not a simple material: it contains In^{+}, In^{2+}, and In_5^{7+} ions. Such novel chemistry occurring within a zeolite can (1) help to understand existing applications of In exchanged zeolites in catalysis and (2) lead to new ones.

Biography

Karl Seff earned his B.S. in chemistry at U.C. Berkeley in 1959, his Ph.D. from M.I.T. in physical chemistry in 1964, and was on the research staff at U.C.L.A. from 1965-1967. Since 1968 he has been a member of the Chemistry Department at the University of Hawaii; he served as its chair from 2000-2003. He has published more than 260 papers in refereed books and journals. Using laboratory techniques and crystallography, he studies the chemistry that can occur within zeolite cavities.