highly sensitive to strain-induced distortions of the crystal lattice. Practical applications of ir and Raman spectroscopy to zirconia technology are discussed.

Basic Science Division will participate with Electronics Division in Joint Session III, "Powder Preparation and Characterization — page 494.

Basic Science Division will participate with White Wares Division in Joint Session IV, "Mechanical Properties and Surface Treatments — page 496.

Basic Science Division will participate with Electronics Division in Joint Session V, "Conductivity and Electrolytes" — page 498.

Wednesday Afternoon • May 6
CONCURRENT SESSION

Room 230 (Civic Center)

"Oxidation — Reduction Kinetics"

Session Chairman: PAUL J. JORGENSEN
Stanford Research Institute, Menlo Park, Calif.

2:00–2:15 p.m.

42–B–70. Low Temperature Parahydrogen Conversion on Gd_2O_3 and Y_2O_3

V. F. CAPOZZI and D. R. ROSSINGTON,* Alfred University, Alfred, N. Y.

Low temperature (77° and 90°K) paraortho hydrogen conversion was studied on two rare-earth oxides, Gd_2O_3 and Y_2O_3. Activation energies, orders of reaction, absolute reaction rates and reaction mechanisms are given, together with the equilibrium surface coverage by adsorbed hydrogen. At these temperatures, conversion reaction proceeds via a physical mechanism on paramagnetic surface sites, and the experimental results are compared with calculated results for three possible physical mechanisms: collisional, vibrational, and translational. It is concluded that the parahydrogen conversion on Gd_2O_3 is paramagnetic, proceeding by the vibrational mechanism. On Y_2O_3 the vibrational mechanism is also predominant, with a possible small contribution by the collisional mechanism. There is some evidence that for Y_2O_3 there may be a contribution by surface free valencies from surface distortion following removal of adsorbed water.

2:20–2:35 p.m.

43–B–70. A Thermodynamic Study of the Ruthenium-Oxygen System

R. W. VEST* and P. DASGUPTA, Purdue University, Lafayette, Ind.

TGA was used to determine the boundary between the Ru and RuO_2 phase fields from 820° to 1130°C and the oxygen partial pressure range of 1.6×10^{-4} to 10^{-2} atm. The Gibbs free energy of formation and standard enthalpy and entropy changes for $RuO_2(s)$ were obtained from the experimentally determined transition temperatures between the two phase fields at various oxygen partial pressures. Results are compared to extrapolated values of earlier studies, and the influence of the higher oxides (RuO_3 and RuO_4) is discussed.

2:40–2:55 p.m.

44–B–70. Influence of Yttrium Additions on the Oxidation Behavior of Ni-Cr-Al Base Alloys at High Temperatures

I. A. KVERNES, Ohio State University Research Fdn., Wright-Patterson AFB, Ohio.

Influence of yttrium additions on the oxidation behavior of Ni-9%, Cr-6% Al alloys in pure oxygen was studied from 800°–1200°C. Experimental methods included TGA, X-ray diffraction, metallographic techniques, electron microprobe analysis and electron microscope studies. In general, oxidation showed less than ideal parabolic behavior. Major reaction products were NiO, Cr_2O_3, Al_2O_3, $NiAl_2O_4$ and a yttrium-aluminum oxide phase. Relative amounts of these were a function of temperature, oxygen pressure and elapsed time of reaction. Addition of yttrium increased the general oxidation resistance; however, yttrium content $\geqslant 0.3$ wt% led to grain boundary oxidation below the surface, which is undesirable from a mechanical property standpoint. Some mechanisms by which yttrium is believed to exert its beneficial influence on the overall attack are discussed.

3:00–3:15 p.m.

45–B–70. TGA of the Oxidation of a ZrB_2 Body Containing SiC

W. C. TRIPP,* Systems Research Labs., Dayton, Ohio, and H. C. GRAHAM, Aerospace Research Labs., Wright-Patterson AFB, Ohio.

Oxidation kinetics of ZrB_2+20 vol% SiC were studied from 800°–1500°C at an oxygen pressure of 250 torr. Since volatile oxides are formed during oxidation, weighing techniques were developed to collect and weigh any oxidation products formed that are condensable within the temperature limits of the system. The balance system measures oxygen consumption, net sample weight change and vaporization rate. By comparing results of these measuring techniques, the relative importance of vaporization on the kinetics can be evaluated. Vaporization of B_2O_3 is significantly retarded above 1100°C by the formation of SiO_2. Apparent anomalies shown by measurements of net weight change are resolved by the additional data provided by oxygen consumption and vaporization rate measurements. Effect on the oxidation kinetics of the addition of SIC is shown by comparing these results with results of a previous study on ZrB_2.

3:20–3:35 p.m.

46–B–70. TGA Oxidation-Reduction Kinetics in MnO

I. BRANSKY, Ohio State University Research Fdn., Wright-Patterson AFB; N. M. TALLAN* and J. M. WIMMER, Aerospace Research Labs., Wright-Patterson AFB, Ohio; and M. GVISHI, Technion, Haifa, Israel.

Gravimetric measurements of the kinetics of oxidation and reduction of single crystal MnO_{1+x} between fixed consumption intervals Δx were made to study chemical diffusion in this oxide. Measurements were made from 1100° to 1450°C; the oxygen partial pressure range was established by CO_2/CO ratios from 1 to 100. Studies of the kinetics as a function of argon dilution of the CO_2/CO mixtures, as a function of the total pressure of the CO_2/CO mixtures, and as a function of specimen thickness all showed a significant influence of the surface reaction rate. Kinetics of oxidation and reduction, at constant temperature and total pressure, were found to decrease rapidly with increasing CO_2/CO ratio. The relation between these apparent changes in oxidation-reduction rates and the influence of surface reaction is discussed.

3:40–3:55 p.m.

47–B–70. Oxidation-Reduction Kinetics in CoO

J. M. WIMMER,* Aerospace Research Labs., Wright-Patterson AFB, and I. Bransky, Ohio State University Research Fdn., Wright-Patterson AFB, Ohio.

Oxidation-reduction kinetics of CoO were studied as a function of temperature, 1000°–1300°C, and deviation from stoichiometry, up to 1%, by TGA and electrical conductivity measurements. It appears that the kinetics are controlled mainly by bulk diffusion so that a chemical diffusion coefficient, $\tilde{\tilde{D}}$, can be calculated from the data. Dependence of $\tilde{\tilde{D}}$ on temperature and stoichiometry will be discussed.

4:00–4:15 p.m.

48–B–70. Oxidation/Vaporization Rates of Cr_2O_3

H. C. GRAHAM* and H. H. DAVIS, Aerospace Research Labs., Wright-Patterson AFB, Ohio.

Weight loss of Cr_2O_3 in oxidizing environments at 1200°C was measured using TGA. Dependence of the weight loss on oxygen partial pressure, gas flow rate, and total pressure was determined independently using oxygen/argon gas mixtures. Mechanism of weight loss is the oxidation of Cr_2O_3 to CrO_3 and its subsequent vaporization. A mass transport coefficient for vaporization of CrO_3 under these conditions is calculated.

4:20–4:35 p.m.

49–B–70. Oxidation of Ni-Cr-1% ThO_2 Alloys at 1200°C

H. H. DAVIS* and H. C. GRAHAM, Aerospace Research Labs., Wright-Patterson AFB, and I. KVERNES, Ohio State University Research Fdn., Wright-Patterson AFB, Ohio.

High temperature oxidation of three Ni-Cr alloys containing