boride compounds behaviour may be strongly influenced by possible valence instabilities of Ce, Eu and Yb ground states. Phase equlibria in metal rich region in the systems with palladium are governed by formation of perovskite-type compounds RPd3Bx and phases near the composition RPd7B2.5. The systems with platinum exhibit phases structurally related to CaCu5-type and both CaCu5- and Laves phases. Including data on the corresponding nickel containing systems, a comprehensive overview will be given (i) on the structural classification of the rare earth-VIIIb group element-borides and (ii) on the corresponding structure-property relations. Acknowledgement. Research is supported by Austrian National Science Foundation FWF Lise Meitner project M1067-N20.

CL-1:IL06 **The Latest Trend in Refractories for Iron and Steelmaking in Nippon Steel Corporation**
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The latest trend of the refractory technology in Nippon Steel Corporation is described breiefly. Amid the ever-increasing proportion of high-grade steels and dramatic changes in crude steel output, the company has steadily reduced specific refractory consumption and enhanced and maintained the international competitiveness of its refractory technology by effectively applying the results from development of new refractory materials and new technologies for furnace construction, repair, diagnosis and recycling for the individual iron and steelmaking processes.

CL-1:L08 **The Effect of Additives on Performance of Chromite Base Ladle Filler Sands for Continuous Casting**
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Nozzle filler is a mixture of refractory raw materials and it is used in the nozzle of ladle in continuous casting of steel. The main goal is to achieve a higher level of free opening performance. High free opening rates of ladles are required in steel making to improve steel quality. The use of an oxygen lance for the artificial opening results in product downgrading by steel oxidation. Free opening rate is mainly determined by the performance of the ladle filler sand. Different types of sands are incorporated into the inner nozzle and well block after ladle preheating in order to act as a filler material. Chromite- based sands are one of the most widely used. Several operative variables and materials characteristics affect their in service performance. In this work a set of chromite ladle filler sands selected and we focused on the understanding of the sintering behaviour of the sands under operative conditions. With this aim, samples were shaped and sintered by different thermal treatments for further microstructural and mechanical evaluations and penetration depth. The present work also deals with the effect of different additives such as carbon and feldspar on performance of the sand.

Session CL-2
Testing

CL-2:IL01 **Testing Procedures for Postmortem Analyses on Refractories Used in Non-Ferrous Furnaces**
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This paper presents the general and particular testing procedures used by the refractories group of UBCeram (Ceramics and Refractories Research and Testing Laboratory) at the University of British Columbia for failure and/or post-mortem analyses on refractories used in non-ferrous smelting, converting and refining furnaces. Selected examples of experimental work are detailed on Flash Furnaces for Ni-Cu and Zn-Pb smelting, Peirce Smith (PS) converters for Ni-Cu matte and Bottom Blown Oxygen Converters (BBOC) for Zn-Pb refining and Pb-Ag cupellation. The general procedures refer to sampling, preparation of the testing specimens and the details of all mandatory and elective tests to be performed, with the specific outcomes to be expected from each particular test and the possible correlations between them. On selected experimental results, the micro structural changes during use were correlated with the physical and mechanical properties of the used and un-used bricks in order to identify the mechanisms of wear. As the penetration and corrosion by the liquid and gaseous environments play decisive roles on the failure or wear, particular laboratory testing methods and experimental set-ups, simulating the industrial conditions, are also presented in a few examples in order to emphasize their role on the total wear during use. An original slag corrosion criterion was used for slag corrosion data processing. Selected experimental results are also presented for hydration, sulphation, penetration and corrosion by Ni-Cu matte, fayalite type slags (NI-Cu and Zn-Pb), erosion by high velocity solid particulates, Boudouard reaction and Kirkendall effect in CO atmosphere and the contribution of complex fumes (Zn, Pb, Cd and Sb) to the mechanisms of wear for magnesia-chrome bricks of burned (B), direct bonded (DB) and rebounded fused-grain (RFG) type.

CL-2:IL02 **How to Enhance Strain to Rupture of Refractory Materials for Thermal Shock Applications?**
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This work is devoted to the study of thermomechanical properties of several industrial and model refractory materials in relation with the evolution of their microstructure during thermal treatments. The aim is, in particular, to highlight the role of thermal expansion mismatches existing between phases which can induce damage at local scale. The resulting network of microcracks is well known to improve thermal shock resistance of materials, since it usually involves a significant decrease in elastic properties. Moreover, this network of microcracks can strongly affect the thermal expansion at low temperature and the stress-strain behaviour in tension. Although these two last aspects are not so much documented in the literature, they most probably also constitute some key points for the improvement of the thermal shock resistance of refractories. Evolution of damage during thermal cycling has been monitored by specific ultrasonic devices at high temperature. Beyond its influence on Young's modulus, this damage also allows to reduce the amplitude of the thermal expansion and to enhance the non-linear character of the stress-strain curves determined in tension. The large increase in strain to rupture, which results from this non-linearity, is of prime interest for thermal shock application.

CL-2:L03 **Thermo Mechanical Comparison Between SFRC With No Cement and a Similar Ultra Low Cement Castable**
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In previous works it was demonstrated that a self flow refractory castable (SFRC) of 100% alumina composed by a matrix of fine particles and a commercial aggregate, it can be optimized to obtain simultaneously a high fluidity in fresh paste and high mechanical resistance after sintering. In present work the performing of this SFRC, with no cement, formed by 3 classes of fine particles (two tabular with size less than 63micra and one reactive alumina CT3000SG) and, three commercial classes of tabular alumina as aggregate (from 0.2 to 3.0mm) was compared with another castable, with 1% of aluminate cement (ultra low cement castable), substituting equal percentage of reactive alumina. It was compared the behaviour on properties as the Flowability Index (FI), setting time, weight reduction, linear shrinkage, density, porosity, water absorption, mechanical resistance, thermal shock, packing density in four phases (dry powders, fluid paste, consolidated green body and after sintering). The castables are also characterized by X-ray diffraction, thermal analysis (TG and DTA) and dilatometry. The results shows that the SFRC with no cement presents higher FI, larger setting time, smaller packing density, smaller weight reduction, smaller shrinkage and higher mechanical resistance.

CL-2:L04 **Fracture Resistance Investigations of Refractory Materials**
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Advanced oxide and nonoxide refractory materials were tested by edge flaking with different standard diamond indenters. Fracture resistance characteristic obtained with the Rockwell indenter (named FR) was calculated from results of direct measurements that did not make use of linear fracture mechanics concepts, which is typical of fracture toughness determinations. It is proportional to the Kc values measured by the single edge V-notched beam (SEVNB) method. The discussed edge fracture (EF) method enables the determination of fracture resistance of ceramics in small-size specimen tests. It has been demonstrated that the EF test method can be quite adequate for enhancing the reliability of comparative fracture resistance estimates and was appropriate for evaluating the uniformity of refractory material items by their fracture resistance. Such tests with small size specimens can be performed on the equipment available in a conventional