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High Temperature Thermal Expansivity Data of Single Crystals of Al_2O_3 and MgO Measured by a New Optical Method, Differential Laser-Interferometry

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There is a continual need for improving the measurements of thermal expansivity, especially in the high temperature region, since at high T thermal expansivity has the least accuracy of those properties needed in EoS and thermodynamic studies. However, there are few measurements of thermal expansivity above 1200 K, except for a couple of standards (Al_2O_3 and MgO). We improved the differential laser-interferometer so that we can remotely measure the changes in length of the samples in the T range from room T to above 1000 K.

The differential laser-interferometer is a new interferometry method, monitoring simultaneously two fringe signals which are 90 degrees out of phase (EOS, vol.74, No.43, 626, 1993). The method has been proven reliable for measuring changes in length to a fraction of a fringe of He-Ne laser light; that is, on the order of 80 Å. We first measure the thermal expansivity of single crystals of Al_2O_3 and MgO in the T range from room T to above 1000 K in order to show the reliability of the new optical apparatus. We compare these thermal expansivity data to previous high T data and/or to the estimated data obtained by extrapolation based on the low T data and the Debye theory. Use of this apparatus has allowed the investigation of the high T thermal dynamics of important minerals in the Earth, such as Mg_2SiO_4, Fe_2SiO_4, FeO, etc.