width 7 mm, thickness 3.5 mm, length 60 mm, outer span 54 mm, inner span 18 mm) (Table I). The DT-values always exceed the data measured with bend specimens. K_{IC} decreases with notch width and is lowest for DT-specimens without a guiding notch. The same may be said for the standard deviation.

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Elastic constants of single crystal manganese–zinc ferrite

Manganese–zinc ferrites find their application in magnetic recording. Both polycrystalline material and single crystals are used for this purpose. The manganese–zinc ratio is chosen for optimal magnetic behaviour. The elastic behaviour of the monocrystalline form of this material is only partly known. Apart from the work of Kawai and Ogawa [1] no data are available. To obtain further information we measured the elastic constants of a Mn–Zn ferrite single crystal.

A Mn–Zn ferrite single crystal was grown in the (1 0 0) direction in an oxygen atmosphere using the Bridgman technique. Details of the experimental set-up will be published separately. The dislocation density in the crystal was approximately 10^6 cm^{-2}. A (1 1 0) slice, oriented within $\frac{1}{2}$ degree of an arc and approximately 1.5 mm thick, was sawn from the crystal. This slice was of uniform thickness, within 2 μm. The composition was checked with the X-ray fluorescence method (Table I). The density was measured by the Archimedes method as elaborated by Prokic [2]. The lattice constant was determined from a powder sample using CuKα radiation. Good agreement was found for the measured and calculated densities. Longitudinal and shear ultrasonic wave velocities, v_l and v_s, were measured at 10 and 20 MHz respectively, using the pulse echo method. From the wave velocities and density the elastic constants c_{11}, c_{12} and c_{44} were calculated [3]. Relative standard deviations were estimated at 0.5%. The results are given in Table I.

Recently Kawai and Ogawa [1] determined Young's modulus in a (1 1 0) bar of single crystalline Mn–Zn ferrite with composition $Mn_{0.53}Zn_{0.35}Fe_{2.12}O_4$. They measured the bar velocity using 125 kHz longitudinal waves and found Young's modulus to be 154 GPa. Calculation of Young's modulus in the (1 1 0) direction from the elastic constants are given in Table I and this results in a value of 188.8 GPa. A difference of roughly 20% is thus found. Apart from the small difference in composition there is no obvious reason for this discrepancy.

From the single crystal elastic constants one can estimate Young's modulus E and Poisson's ratio ν for the fully dense polycrystalline material using the Voigt–Reuss–Hill [4] or Hashin–Shtrikman [5] averaging scheme. This results in $E = 180$ GPa and $\nu = 0.326$. These values agree very well with $E = 177.7$ GPa and $\nu = 0.326$ as determined by Tanaka [6] for dense polycrystalline Mn–Zn ferrite with a composition comparable to that of the ferrite used in this investigation. However, these measurements were done on a mag-

TABLE I Properties of single crystal Mn–Zn ferrite

Property	Value
Composition	$Mn_{0.45}Zn_{0.50}Fe_{2.05}O_4$
Density	5.133 g cm^{-3}
Lattice constant	0.8480 nm
v_l (1 1 0)	7.339 km sec^{-1}
v_{s1} (1 1 0)	4.152 km sec^{-1}
v_{s2} (1 1 0)	2.980 km sec^{-1}
c_{11}	234 GPa
c_{12}	142 GPa
c_{44}	88.5 GPa

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netically fully saturated material. Unmagnetized specimens could not be measured because the attenuation was too high.

We therefore determined the longitudinal wave velocity of a 99.6% dense polycrystalline specimen of $Mn_{0.49}Zn_{0.45}Fe_{2.06}O_4$. The measured value of $7.190\,km\,sec^{-1}$ agrees very well with the one calculated from the single crystal elastic constants ($7.157\,km\,sec^{-1}$) according to the Voigt–Reuss–Hill or Hashin–Shtrikman averaging scheme. In our case too, excessive damping prevented the measurement of the shear-wave velocity in polycrystalline ferrite.

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Phase equilibrium diagram of the system ceria–yttria for temperatures between 900 and 1700° C

Interest in the search for compounds of high melting point oxides suitable for non-traditional applications prompted an investigation of ceria-based materials. Previously reported results [1, 2] have indicated that these materials could be successfully employed at high temperatures as semiconductors. Mixtures of ceria with alkaline-earth oxides have been examined in earlier papers [3–12]. Investigations have also been made of the system CeO_2–ZrO_2 [13, 14], and of those ternary systems containing the two oxides mentioned and other high melting point oxides such as CaO [15], MgO [16], Al_2O_3 [17, 18] and BeO [19].

The present paper reports on an investigation of solid-state phase relationships in the system ceria–yttria in the temperature range between 900 and 1700° C. No information about this system could be found in the literature.

The materials used were CeO_2 (99.9% pure) and Y_2O_3 (99.99% pure). To prepare the stoichiometric mixtures, the compounds were weighed, homogenized by hand-mixing in agate mortars for 4 h, pressed, at a pressure of $3000\,kg\,cm^{-2}$, into discs and pre-heated in an oxidizing atmosphere (air) for 500 h at 1400° C. After this treatment, the specimens were re-fired at the following temperatures and time periods: 1700° C, 8 h; 1600° C, 16 h; 1500° C, 500 h; 1400° C, 1000 h; 1300° C, 1200 h; 1200° C, 1500 h; 1100° C, 1800 h; 1000° C, 2000 h; 900° C, 2500 h. All firings were conducted in an oxidizing atmosphere (air); the firing times were all long in order to ensure the attainment of true equilibrium conditions. In all cases the completion of the reaction was checked experimentally by microscopic and X-ray analyses carried out on the specimens at regular intervals in the course of firing. Equilibrium was considered attained and the reactions completed when successive microscopic observations revealed no more variations in the number and proportions of the phases present and the intensities of their diffraction lines remained unchanged in successive X-ray diffraction pattern measurements. To freeze the equilibrium phase relations at the various firing temperatures, the specimens were always quenched in air. The phase relations at the different firing temperatures were determined for the quenched specimens by reflected-light optical microscopy and X-ray diffractometry. The techniques used and the precautions taken, in the preparation of the specimens for the microscopic and X-ray examinations, are described elsewhere [15, 17].

The results obtained are presented in the phase equilibrium diagram between 900 and 1700° C (see Fig. 1). There existed two relatively extensive areas of binary solid solution and no

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