The data presented in this article are related to the research article entitled “Phase stability and transport characteristics of (ZrO$_2$)$_{1-x}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$ and (ZrO$_2$)$_{1-x-y-z}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$(Y$_2$O$_3$)$_z$ solid solution crystals” https://www.sciencedirect.com/science/article/pii/S2352340917302329 [1]. It contains data on densities and micro-hardness of the as-grown crystals. The data on the specific conductivity of the as-grown and annealing at 1000 °C for 400 h ScCeSZ and ScCeYSZ crystals in the temperature range 623–1173 K is also included in this article. The article describes also the growth of the (ZrO$_2$)$_{1-x}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$ and (ZrO$_2$)$_{1-x-y-z}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$(Y$_2$O$_3$)$_z$ solid solution crystals using directional melt crystallization in a cold crucible.

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1. Data

This dataset contains information about density, microhardness and specific conductivity of the scandia-ceria- and yttria-stabilized zirconia. Table 1 shows the chemical composition, brief notations, densities and microhardness of the as-grown crystals used in the further analysis. Table 2 shows the specific conductivity of the as-grown and annealing at 1000°C for 400 h ScCeSZ and ScCeYSZ crystals in the temperature range 973–1173 K. Arrhenius plot of specific bulk conductivity of as-grown and as-annealed crystals ScCeSZ is shown in Fig. 1. The same plot for as-grown and as-annealed crystals ScCeYSZ is shown in Fig. 2.

2. Experimental design, materials, and methods

All of the samples having nominal composition (ZrO$_2$)$_{1-x}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$ ($x = 0.085–0.10$; $y = 0.005–0.015$) and (ZrO$_2$)$_{1-x-y-z}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$(Y$_2$O$_3$)$_z$ ($x = 0.07–0.10$; $y = 0.005–0.010$; $z = 0.005–0.020$) were prepared by directional melt crystallization in a cold crucible. ZrO$_2$, Sc$_2$O$_3$, CeO$_2$, and Y$_2$O$_3$ powders of not less than 99.99% purity grade were the initial materials. The crystallization of the melt was carried out in a water-cooled crucible 130 mm in diameter. The RF generator (frequency 5.28 MHz, maximum output power 60 kW) was used as a power source. The charge weight was 5 kg. The directional crystallization of the melt was achieved by moving the crucible with the melt downward relative to the induction coil at a 10 mm/h rate. The weight of the ingots was 3.5–4.0 kg. After the installation was shut down the ingot cooled down spontaneously. The cooling of the ingots was monitored by measuring the temperature on the surface of the upper heat screen with a Gulton 900–1999 radiation pyrometer (above 1000°C) and a Pt/Pt-Rh thermocouple (1000°C down to 500°C). The average ingot cooling rate from the melt temperature to 1000°C was 150–200 K/min and then down to 500°C with 30 K/min. The process yielded ingots consisting of column crystals that could be mechanically separated into individual crystals. Typical dimensions of the crystals were 8–15 mm in cross-section and 30–40 mm in length.
The as grown crystals were then annealed in a Supertherm HT04/16 high-temperature resistance furnace in air at 1000 °C for 400 h.

The conductivity of the zirconia base crystals was measured in the 400–900 °C range using a Solartron SI 1260 frequency analyzer in the 1 Hz–5 MHz range. The resistivity was measured in a measurement cell using the four-probe method in a Nabertherm high temperature furnace (Nabertherm GmbH, Germany). The measurements were carried out on crystal plates size of 7 × 7 mm² and thickness of 0.5 mm with symmetrically connected Pt electrodes. Platinum electrodes were annealed in air at the temperature 950 °C for 1 h. The ac amplitude applied to the sample was 24 mV. The impedance frequency spectrum was analyzed in detail using the ZView (ver.2.8) (Scribner Associates Inc., USA) software. The resistivity of the crystals was calculated based on the resultant impedance.
Fig. 1. Arrhenius plot of specific bulk conductivity of as-grown and as-annealed ScCeSZ.

Fig. 2. Arrhenius plot of specific bulk conductivity of as-grown and as-annealed ScCeYSZ crystals.
spectra and then the specific conductivities of the crystals were calculated taking into account the specimen dimensions.

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**Transparency document**

Transparency document associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2019.104061.

**References**

[1] D.A. Agarkov, M.A. Borik, V.T. Bublik, A.S. Chislov, A.V. Kulebyakin, I.E. Kuritsyna, V.A. Kolotygin, E.E. Lomonova, F.O. Milovich, V.A. Myzina, V.V. Osiko, N.Yu. Tabachkova, Phase stability and transport characteristics of (ZrO$_2$)$_{1-x}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$ and (ZrO$_2$)$_{1-x,y}$(Sc$_2$O$_3$)$_x$(CeO$_2$)$_y$(Y$_2$O$_3$)$_z$ solid solution crystals, J. Alloy. Comp. 791 (2019) 445–451.

[2] M.A. Borik, S.I. Bredikhin, V.T. Bublik, A.V. Kulebyakin, I.E. Kuritsyna, E.E. Lomonova, F.O. Milovich, V.A. Myzina, V.V. Osiko, P.A. Ryabochkina, N.Y. Tabachkova, Structure and conductivity of yttria and scandia doped zirconia crystals grown by skull melting, J. Am. Ceram. Soc. 100 (2017) 5536–5547. https://doi.org/10.1111/jace.15074.