# DF 18: Nanostructured oxide thermoelectrics

Time: Wednesday 12:30–13:30 Location: H9

DF 18.1 Wed 12:30 H9

**Thermoelectric properties of p-type $Bi_2Sr_2Co_2O_9$ glass-ceramics** — •Matthias Jost[1,3], Julian Lingner[1,2], Martin Letz[2], and Gerhard Jakob[1] — [1]Johannes-Gutenberg Univeristät, Institut für Physik, Staudinger Weg 7, Mainz D-55128 — [2]Schott AG, Hattenbergstraße 10, Mainz D-55122 — [3]Technische Universität Darmstadt, Institut für Mikrowellentechnik und Photonik, Merckstraße 25, Darmstadt D-64283

In the oxide system of Bi-Sr-Co glass melts were prepared by adding a small amount of glass formers. A crystallization leads to crystalline phases of $Bi_8Sr_8Co_4O_25$, $BiSrCo_2O_x$ and $Bi_2Sr_2Co_2O_9$ (BC-222) densely embedded into a residual glass phase. We show that it is possible via such glass-ceramic approach to obtain microstructured bulk material with low thermal conductivity and relatively high electrical conductivity. We further show that these materials are stable under thermal cycling for temperatures up to 700°C. A characterization of the thermoelectric properties leads to values of ZT between 0.008 and 0.018.

DF 18.2 Wed 12:50 H9

**Glass-ceramics as a new material class for high temperature oxide thermoelectrics** — •Julian Lingner[1,2], Gerhard Jakob[1], and Martin Letz[2] — [1]Universität Mainz — [2]Schott AG Mainz

The research on thermoelectric materials has progressed enormously over the last years and is still growing because of the global demand for eco-sensitive energy conversion. Innovative approaches like bulk-nanostructuring helped to increase the efficiency of the investigated materials. Materials which withstand high temperatures above 500°C are especially in great demand because the thermoelectric efficiency is proportional to the temperature and the possible fields of application broaden. It is of great importance to find materials which are able to operate under these circumstances while at the same time being naturally abundant and non-toxic. This presentation focuses on glass-ceramics as a new material class for high temperatures in thermoelectrics. Starting from a base glass via a controlled thermal treatment, a certain crystal structure is embedded in the glass-matrix leading to many new properties of the material. Especially the possibility to induce small crystallites, the pore-free surface combined with the high-temperature durability of this material class support this approach. Measurements of different systems of glass-ceramic thermoelectric materials are presented.

DF 18.3 Wed 13:10 H9

**Indium-oxide-based Seebeck gas sensors** — •Markus Mischo[1], Volker Cimalla[2], Oliver Ambacher[1,2], and Friedemann Völklein[3] — [1]Laboratory for Compound Semiconductor Microsystems, Department of Microsystems Engineering - IMTEK, University of Freiburg, Germany — [2]Fraunhofer Institute for Applied Solid State Physics Freiburg, Germany — [3]RheinMain University, Institute of Microtechnologies

The intention of this research is to develop a highly sensitive long-lasting ozone sensor based on the thermoelectric effect. The thermoelectric, or Seebeck effect is the direct conversion of temperature differences into electricity. Direct thermoelectric gas sensors are based on the dependency of the Seebeck coefficient on the surrounding gas concentration. Beside the Seebeck coefficient there are several other important parameters which have an influence on the thermoelectric power. Generally, the thermoelectric power is characterized by the figure of merit ZT: $ZT = (S^2\sigma/\kappa)T$ where S, $\sigma$, $\kappa$ and T are the major influencing parameters, namely the Seebeck coefficient, the specific electronic and thermal conductivity, respectively, and the temperature. Compounds such as InN, InAs, and InOx have good thermoelectric properties. In addition, the Fermi level and the surface band bending can be modified by specific gas adsorption, while thermal conductivity is decreased by reducing the grain size in the material. These effects are used for a highly-sensitive Seebeck gas sensor. The sensors are able to compete with conventional resistive gas sensors regarding accuracy, reproducibility and response time.