Visit of the National Institute for Materials Science, Research Center for Functional Materials, Optical Single Crystals Group of Prof. Dr. Kiyoshi Shimamura and Dr. Encarna Garcia Villora in Tsukuba, Japan on Nov 9, 2018.

Presentation title:

"Crystal growth of oxides and fluorides for novel applications"

Matthias Bickermann
Department head and deputy director, Leibniz-Institut für Kristallzüchtung (IKZ), Berlin, Germany; and professor for chemistry, Technische Universität Berlin, Germany

In my presentation, I will introduce the research activities and facilities of IKZ crystal growth and subsequently focus on the preparation, challenges, and resulting properties of several single crystals grown at IKZ as follows:

The IKZ is a government-funded research and service institute in Germany dedicated to investigate the scientific-technical fundamentals of crystal growth, processing and physico-chemical characterization of crystalline solids by theory and experiment. The department Dielectric and Wide Bandgap Materials focuses on the bulk crystal growth of nitrides, oxides, and fluorides. Our mission is to prepare and to provide single crystal materials with tailored properties and high yield for use as substrates or bulk material in novel and energy-efficient electronic, optoelectronic, optical/laser, and piezo-/ferroelectric applications.

Gallium oxide (β-Ga_2O_3) single crystal boules of up to 2 inch in diameter are grown by the Czochralski (CZ) method to prepare substrates for novel power electronics devices. The CZ method provides significant challenges in regard to gallium oxide growth [1], but also offers important benefits for substrate manufacture. Furthermore, the technology can be extended to provide novel semiconducting gallate compounds [2]. For strontium titanate ($SrTiO_3$), a combination of EFG and flux growth methods was developed to overcome the limitations in structural quality currently imposed by the use of the Verneuil (flame fusion) technique [3]. Our current research focus is to provide substrates with tailored lattice (mis-)match to novel multiferroic and semiconducting oxides such as BeFeO3, EuTiO3, BaSnO3 and others [4]. Finally, I will briefly present our vision to prepare doped rare-earth sesquioxides for laser applications and fluorides for optical applications.

[1] Z. Galazka et al., ECS J. Solid State Sci. Technol. 6 (2017) Q3007-Q3011

[2] Z. Galazka, Phys. Status Solidi A 212 (2015) 1455-1460

[3] C. Guguschev et al, CrystEngComm 17 (2015) 4662-4668

[4] R. Uecker et al., J. Crystal Growth 457 (2017) 137-142