Special Issue by Guest Editors: “Modern Trends in Advanced Ceramics”
Dedicated to Professor Günter Petzow on the Occasion of his 80th Birthday

Preface

This special issue of Journal of the Ceramic Society of Japan is dedicated to Professor Günter Petzow on the occasion of his 80th birthday. The present selection of papers is in recognition of his outstanding contributions to ceramics science and technology. With respect to Professor Petzow’s lifework, the papers are authored by former collaborators and cover various aspects of modern trends in advanced ceramics including synthesis, processing and sintering techniques applied for the development of novel structural and functional ceramics and ceramic composites. The contributions highlight the increasing technological significance of advanced ceramic materials and present concepts for the production of novel multifunctional ceramics with tailor-made microscale and/or nanoscale structure.

Born in Nordhausen/Germany on 8th July 1926, Professor Petzow enjoyed a long and highly successful research career in the field of physical metallurgy and materials science, primarily focusing on constitution, powder metallurgy, metal and ceramic research. He studied Chemistry and Physical Metallurgy at the University of Stuttgart, where he received his Master Degree (Dipl.-Ing.) in 1956 and completed his PhD thesis on “The quaternary phase diagram silver-copper-cadmium-tin” in 1959. Shortly afterwards he became research associate at the Max-Planck-Institute for Metals Research, Institute for Special Metals, where he served as head of the research groups: constitution and metallography.

Particularly noteworthy is the instrumental role Professor Petzow played in establishing the Powder Metallurgy Laboratory (PML) in the 1960s. It was largely due to his dedication and commitment in his capacity as head of the PML that the Laboratory soon produced remarkable results, attracted scientists from abroad and gained a worldwide reputation. Research focus, initially on beryllium, rapidly expanded to include a whole range of component systems, e.g. coloured metals, rare earth metals, non-metals and ceramic-forming ion types.

During his early research career Professor Petzow gained the positions of Scientific Member of the Max-Planck-Society and member of the board of directors of the Max-Planck-Institute for Metals Research, Stuttgart in 1973. The following year he became Extraordinary Professor at the University of Stuttgart, where he lectured in equilibrium phase diagrams and powder metallurgy. In 1977 he received the appointment of Honorary Professor at the University of Berlin. In the 1980s he was promoted to Vice Director of the Max-Planck-Institute (MPI) for Metals Research, where he also served as Director of the National School for Metallographers as well as Head of the High-tech Ceramic Division and supervisor of the construction of the Laboratory for Ceramic Research. In his capacity as Chairman of the Coordinating Committee of the Ceramic Project between the MPI and four renowned companies (Daimler-Benz AG, Hoechst AG, Bayer AG, and MTU), Professor Petzow played a decisive role in successfully forging links between his research community and industry. In 1989 Professor Petzow was promoted to Executive Managing Director of the Max-Planck-Institute for Metals Research. Throughout his many years as an active researcher, Professor Petzow’s interactive nature was manifested by his close connections with international research organizations where he served as guest professor. He, in turn, received many visiting scientists from around the world.

Together with his research team, Professor Petzow set many milestones in the field of phase equilibrium, especially in the development of analytical rules for decay reaction in high component systems. In collaboration with his colleagues, he also carried out investigations into powder metallurgy. They discovered and analyzed the phenomenon of particle rearrangement in the sintering process and proceeded to conduct studies on liquid phase sintering. This work resulted in the development of one of the first models encompassing the phenomenon as well as the discovery of chemically driven grain boundary movement.

Professor Petzow dressed in a traditional Japanese Kimono.
With regard to high performance ceramics and the methodology to their development, Professor Petzow dealt with concepts for tailoring the microstructure of materials in order to optimize their properties. He embarked on improving the sintering technique, the strength and toughness of materials as well as the model description of crack propagation and its interplay with the characteristics of the microstructure. To date, his research in the field of microstructural engineering has contributed to gaining a better understanding of the influence of material structure on material properties.

The extent of Professor Petzow's fascination for many aspects of materials science and physical metallurgy is clearly reflected in hundreds of publications and numerous patents. Most of the authors contributing to this special issue have had the honour of co-authoring papers with Professor Petzow. The overwhelmingly broad spectrum of his research activities is documented in countless highly acclaimed publications encompassing topics such as constitution and properties of cermets, metallography, beryllium and its compounds, high-temperature materials, liquid phase sintering, particle rearrangement, metallographic etching, sialon-ceramics, sintering of Si₃N₄-ceramics, metal-ceramics interfaces and processing of advanced ceramics. The following publications are only representative examples of Professor Petzow's active involvement in scientific journals and books: co-founder and scientific editor of Practical Metallography and Powder Metallurgy International, Member of the Scientific Editorial Board of Metallography, Materials Characterization, International Metals Reviews and Advanced Materials, and co-editor of the book series Ternary Alloys.

Professor Petzow's expertise was often sought by scientific organizations, where he acted in an advisory capacity, e.g. International Advisor of the National Research Institute for Metals, Japan, Consultant for the German Ministry of Research and Technology, Advisor and Lecturer of the Technical Academy Esslingen, Germany. He was also a board member of distinguished research societies including German Society of Materials (DGM), German Ceramic Society (DKG), European Powder Metallurgy Federation (EPMF) and Fraunhofer Institute for Silicate Research.

In recognition of Professor Petzow's major scientific accomplishments and his continuous dedication to science, he was granted a vast array of distinctions and honours. An overwhelming number of honorary Doctorates, Professorships and memberships were presented to him by leading research institutes around the globe. For his dedicated services to science he was granted countless prizes and awards including the Henry-Clifton Sorby Award, the Hume-Rothery Prize, the Bundesverdienstkreuz 1st class order for national merits, and the Roland-Mitsche Prize.

While Professor Petzow was engaged in research activities in many countries, his professional and personal connections with Japan deserve special attention. From an early stage in his career he established close contact with Japanese scientists, who in turn recognized Professor Petzow's remarkable contributions to scientific progress. Among the prestigious Japanese awards granted to Professor Petzow are: The Order of the Rising Sun with Golden Rays and Blue Neck Ribbon of the Japanese Emperor (1995), the Great Honda-Prize for Distinguished Achievements in the Field of Eco-Technology, Honda Foundation, Japan and the Centennial Award of the Japanese Society of Ceramics, Tokyo. On a more personal level, it was during the time Professor Petzow devoted to research work in Japan that he developed a strong affinity for Japanese culture, especially the decorative and symbolic Japanese landscape gardens, a passion he still pursues to this day.

On behalf of the contributing authors, it gives us great pleasure to extend our best wishes and warmest greetings to Professor Petzow on his 80th birthday. As a prolific researcher and author, he has won the admiration and respect of his collaborators, the research community and scientists worldwide. He has played a pioneering and influential role in the study of constitution, powder metallurgy, metals and ceramics. His truly innovative contributions to ceramics science and technology certainly have a lasting impact on advancements in material properties.

Ralf Riedel
(Darmstadt University of Technology, Germany)
Fumihiro Wakai
(Tokyo Institute of Technology, Japan)