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Advanced ceramics for energy systems

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Advanced ceramic materials offer enormous potential for innovations in the fields of efficient energy conversion and storage as well as environmental technology. The joint application of structural and functional ceramic technology allows for unique combination of electronic, ionic (electrochemical) and mechanical properties enabling the development of new, highly integrated systems. We present specific examples for Fuel Cell, Li-ion and high temperature Na-metal batteries as well as ceramic membrane systems development. As a first example, high temperature fuel cell systems developments for both mobile and stationary applications are presented. In the power range from 1 W to several 10 kW we use SOFC (solid oxide fuel cell) technology, for the high power range up to several MW we prefer MCFC (molten carbonate fuel cell) technology. Both fuel cell types use conventional hydrocarbon fuels and are currently being commercialized. Using related ceramic technology platforms we also develop energy storage systems in different power ranges. Examples for fabrication of Li-Ion batteries as well as high temperature NaNiCl batteries are presented. The production of both, power generation and storage systems require new approaches for non-destructive in line testing methods which are discussed as well. For illustration of the potential of advanced ceramic materials in environmental technology, ceramic membrane systems are discussed. Ceramic membranes can be used for micro-, ultra- or nano- filtration of liquids. Further innovations require an improved control and reduction of pore size. This allows for new applications in gas separation and pervaporation systems. For this, pores sizes below 1 nm have to be generated using specific structural features of selected materials.

Biography

Alexander Michaelis is the Director of Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Germany. He studied physics and received his Doctorate in the field of electrochemistry. In 1996 he accepted a position at Siemens AG working in the field of microelectronics amongst others at the DRAM Development Alliance in East Fishkill, New York. In 2000, he began to work for Bayer AG in Leverkusen changing subsequently to H.C. Starck GmbH, a Bayer subsidiary, where he was head of the Electroceramics and the New Business Development department. Furthermore, he was the Managing Director of InDEC B.V. working in the field of solid oxide fuel cells and finished his state doctorate at University of Düsseldorf. Since 2004, he has been director of the Fraunhofer Institute for Ceramic Technologies and Systems IKTS and has been holding the chair of Inorganic Nonmetallic Materials at TU Dresden. He has more than 40 patent families in materials science, microelectronics, and electronics and provided more than 100 publications. In 2012 he was awarded the ACerS Bridge Building Award for his contribution in the field of energy and environmental technology.

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