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Preface

IWCC7 and future concepts in energy-related catalysis

The Seventh International Workshop on Catalytic Combustion (IWCC7), augmented with topics from energy-related catalysis, was held at the lake of Zürich, Switzerland, September 29 to October 1, 2008. Building on the tradition of six successful previous workshops, wherein emphasis was placed upon power generation catalysis (mainly gas turbines), IWCC7 has been expanded to address additional energy-related issues of heterogeneous catalysis. The workshop has been arranged in four thematics. The first one deals with the conventional catalytic combustion for power generation, which has been the driving force for the established IWCC community. The second topic addresses fuel processing (notably catalytic partial oxidation), whereby focus is on reforming not only as applied to power generation systems but also to general chemical engineering processes. Catalytic microreactors for portable power generation have received increased attention in the last years, and constitute the third thematic of the workshop. Finally, catalytic exhaust gas treatment for pollutant abatement in internal combustion engines is addressed. Exhaust gas treatment and part of the fuel processing topics constitute new directions of the workshop outside traditional gas turbine power generation.

In the first thematic of gas turbine catalytic combustion for large-scale power generation, T. Griffin and R. Carroni reviewed recent developments in fuel lean catalytic combustion of natural gas, achieved within the European CATHLEAN project. Corresponding progress in the more recent methodology of fuel rich catalytic combustion for gas turbines is presented by researchers from Precision Combustion (USA). O. Deutschmann presented numerical models for optimization of high-temperature catalytic reactors used in power generation. Other contributions addressed catalyst development for either fuel lean or fuel rich catalytic combustion. Palladium, platinum and rhodium catalysts as well as noble-metal substituted hexaaluminates are the catalysts of interest for natural gas fueled power systems.

In fuel processing, J. Bøgild-Hansen reviewed fuel processing systems (FPS) of both low and high-temperature fuel cells, while D. Trimm explored relative advantages of cascade reactors versus single microchannel reactors for the production of chemicals (methanol from natural gas and paraffin dehydrogenation). Remaining contributions investigated catalytic partial oxidation of methane and higher hydrocarbons.

Microreactors for portable power generation have recently been intensively investigated due to their considerably higher power densities compared to state-of-the art Li-ion batteries. Their large surface-to-volume ratios favor heterogeneous fuel conversion, leading to a variety of catalytic microreactor designs. D. Vlachos reviewed the potential of catalytic microreactors and the combustion stability at millimeter and sub-millimeter geometrical confinements. The effect of geometry on the thermal behavior of microreactors is addressed by A. Di Benedetto and the construction and testing of a microreactor for a micro-turbine power generation system by J. Mantzaras and co-workers.

Exhaust gas treatment for emissions control in internal combustion engines is an area of intense research with a broad scientific audience. P. Forzatti reviewed NO_x storage-reduction (NSR) catalytic systems for NO_x removal under lean conditions. Ageing aspects of modern exhaust gas treatment automotive systems were investigated by A. Winkler.

The contributions included fundamental and applied research work as well. In particular, numerical modeling is well represented given the impressive developments in this field over the last years. Direct numerical simulation (DNS) of catalytic systems is nowadays feasible, at least for single channel geometries. Such modeling advances greatly simplify reactor design as exemplified by the topical review presentations.

Alexander Wokaun
John Mantzaras*
Peter Jansohn
Paul Scherrer Institute, General Energy Department, CH-5332 Villigen PSI, Switzerland

* Corresponding author. Tel.: +41 56 3104046; fax: +41 56 3102199.
E-mail address: ioannis.mantzaras@psi.ch (J. Mantzaras)

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