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EDITORIAL

For peaceful worldwide prosperity development, several tremendous challenges have to be addressed during the next decades. Food, water and energy have to be made available for 8–10 billion people, poverty and hunger should be significantly reduced, while present environmental damage should be decreased and future damage minimized. Among these problem areas, reasonably priced clean energy is by far the most important, as it can help to solve several of the mentioned questions.

In order to get there, all available and particularly climate friendly energy sources have to play their role, while energy conservation must be drastically improved. The availability of oil, which has allowed the 20th century development of mankind, will be reduced and there is probably no specific energy source that alone could play the corresponding role in the future.

Keeping these statements in mind, we want to present to a critical, scientifically aware audience, chemistry and materials aspects of present mainly light water reactor (LWR) energy systems, which operate primarily for electricity production.

We know the advantages of LWRs which lie in a) high energy earning factors (ratio between energy input and output), b) seasonally and daily independent (base load), high power density production possibilities, c) low cost energy with small waste volume arisings, d) simplicity of prime energy storage, e) resource independence of instable political regions of the world and, last and not least, f) the absence of climate-active exhaust gases.

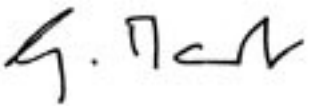
We are also aware of the problem areas of nuclear production systems, which lie in large-scale accident questions, waste treatment and final storage demonstration, proliferation risks and ultimately, public acceptance.

We are excited to give an overview about chemistry in nuclear power production. As the topics were selected on the basis of their material and chemistry relevance, questions about nuclear physics and reactor control are only marginally dealt with and summarized in an introductory tutorial (paper No. 1), addressing physics, power plant principles and materials.

In the context of planning the world's future, which has to rely on sustainable energy production systems, a special paper (Nr. 2) looks into the pillars of sustainability and compares nuclear with non nuclear energy production options.

We then focus on chemistry issues with respect to the nuclear fuel cycle, including obviously questions of a nuclear waste repository (papers 3–6). Next we look at materials and chemistry questions related to the operation of LWRs (papers 7–11). From the very beginning of nuclear power production great care had to be taken to cope with low frequency accident scenarios, which might lead to a destruction of the fuel integrity and possibly to radionuclide release, radioactive exposure of the population and land contamination. Papers 12 and 13 therefore look at questions related to so-called design basis accidents and very rare, hypothetical, beyond design accidents respectively. One should be aware that during the approximately 40-year period of western light water reactor application, with a cumulative experience of approximately 10'000 years of reactor operation, no accident has ever led to a harmful health impact of the population and/or land contamination (the Chernobyl accident was caused by the use of different technology with low safety standards combined with deficient safety culture). Finally, as we are aware of deficiencies in some sustainability aspects of present day LWRs, we present an outlook to next (paper 14), and over next generation (GEN-IV) nuclear power production systems (papers 15–16), which have to guarantee very high non-proliferation standards, produce less long living radioactive waste, be free of possible plant emergencies which might call for an evacuation of the population and/or could lead to land contamination, could contribute, if requested, high temperature process heat, and, last but not least, be economical and publicly accepted.

The nuclear scientific community has lost in the past part of the public confidence, -acceptance and -enthusiasm of the early days and it has learnt to be modest and open minded. A prerequisite to solve the future world's energy demands is our motivation to educate and develop a highly skilled, strong community of young academics and engineers in natural sciences, who carry out research and engineering on all possible auspicious energy supply technologies, who are working together in a positive attitude without negative preconceptions. Likewise as a population, we need targets free of fundamental ideological prejudice.



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