Editorial

Optics in Energy: the power of optical solutions

The celebration of the 50th anniversary of the laser this year reminds us of the pervasiveness of optical technologies and their impact on Society in numerous positive ways. For instance, advances in lasers and optical fibers have revolutionized information technology and telecommunications, creating a global network that has led to the internet and changed the world's economy. Likewise, optics had a dramatic impact on medicine, health care, and the life sciences in areas like advanced imaging techniques or DNA sequencing, to cite just a few. While these great discoveries enabled by optics marked the last decades of the 20th century, the century ahead poses new challenges to sustain our civilization's continuing advancement. Foremost among these challenges is the need to develop new clean sources of energy while preventing or reversing the degradation of the environment. Optics is likely to play a key role in dealing with this challenge. Among renewable energy sources, solar energy shows great potential as the sun provides the earth with more energy in an hour than is consumed by the world's population in a year. While solar thermal and photovoltaic technologies are quite mature, their scale remains small with a total energy market share of less than one percent. Hence, making solar energy more efficient and more economical compared to oil, natural gas and coal, remains a challenge that is driving new research and innovations worldwide. Several new approaches are being explored to capture, convert, and store the optical power from the sun. For instance, the thermophotovoltaic approach has the potential to yield to power conversion efficiencies that exceed the maximum theoretical value for single p-n junction cells. Another source of energy includes nuclear fusion, the artificial re-creation by man of the sun's power. While fusion has already been demonstrated on a small scale, it remains a grand challenge to make it economical. Hence, several approaches to fusion are being studied including inertial confinement fusion (ICF) at the National Ignition Facility (NIF) where 192 high power laser beams are focused onto a tiny spherical target filled with deuterium and tritium.

Despite anticipated advances in these new sources of energy, it remains unlikely that fossil fuel powered power plants will be eliminated anytime soon, leaving environmental challenges for scientists and engineers to address. Minimizing the adverse effects of carbon dioxide released during the combustion of fossil fuels is a challenge that can be addressed by exploring and studying new combustion processes that involve new fuels or that can ease carbon dioxide sequestration. Lasers can serve as advanced diagnostic tools for the development of new and cleaner combustion processes. Another environmental concern deals with the concentration of nitrogen in the atmosphere which is critical for the growth of plants and which is being impacted by human activity. Monitoring nitrogen levels in the atmosphere using spectroscopic techniques is critical to sustain adequate food supplies. From making solar energy economical to providing energy from fusion, to developing carbon sequestration methods, to managing the nitrogen cycle, in all these grant challenges optics is poised to play a central role.

In other areas of technology, optics can lead to significant energy savings. For instance, solid-state lighting is undergoing transformative changes because of recent advances in the growth of compound semiconductors such as InGaN/GaN and the synthesis of organic semiconductors. Organic light-emitting diodes (OLEDs) have already reached internal quantum efficiencies near 100% in the green, shifting the focus from material optimization to light extraction, an area where optical solutions will make a difference. With laboratory efficacies larger than 100 lm/W, both inorganic light-emitting diodes (LEDs) and OLEDs have surpassed in performance conventional light sources such as incandescent and compact fluorescent lamps, and are competing directly with large fluorescent tubes. Recent laboratory results suggest that values beyond 150 lm/W are within reach.

The list of areas of science and engineering in which optics can impact energy and sustainable is long and the most important areas might still be missing from the list. Hence, as we move further into the 21st century, optical scientists and engineers will need an academic forum to exchange and share their latest discoveries that deal with optics in energy. The mission of the new journal *Energy Express* is to serve that purpose and become the number

one international journal for optical research in energy and sustainable development while building on the highest standards of quality in research and scholarship maintained by the publications of the Optical Society of America.

The creation of *Energy Express* is an outcome of OSA's Energy Advisory Group formed under the leadership of Jim Wyant the current President of our Society. His vision was to position OSA as the leading source of information on optical technologies related to energy research innovations and commercial applications. During 2009, the Energy Advisory group comprising Tom Baer (Stanford Univ., 2009 President of OSA), Gary Bjorklund (Bjorklund Enterprises), Doug Hall (Corning Inc.), Ray Kostuk (Univ. of Arizona), Fred Leonberger (EOvation Technologies), Richard Powell (Univ. of Arizona), Joe Simmons (Univ. of Arizona), Bob Smythe (Smythe Management Consultants), Roland Winston (Univ. of California Merced), and myself, participated in regular conference calls and discussed how to implement such a vision. These discussions resulted in the decision to launch the new journal *Energy Express.* I was honored and humbled when asked to serve as founding Editor of the new journal.

Instead of launching a new stand alone journal, we decided that *Energy Express* would start as a Supplement to *Optics Express* the leading open-source publication in optics. Its Editor-in-Chief, Martijn de Sterke (Univ. of Sydney), showed full support for this initiative since day one, and I want to take this opportunity to sincerely thank him for his energy and his leadership. I also extend my thanks to all the staff of *Optics Express* and its Associate Editors. This first issue of *Energy Express* could not have been possible without the relentless help of all the staff coordinating OSA's publications, and I want to express my gratitude to them as well.

To highlight the importance of optics in Energy, *Energy Express* will publish a series of Focus Issues dedicated to selected research areas. With this inaugural issue of the Supplement, we have included a first focus issue on Solar Concentrators for which Roland Winston (Univ. of California Merced) has agreed to serve as Guest Editor. Coordinating such a focus issue is a daunting task that takes a lot of dedication. I hope that the readers of *Energy Express* will appreciate this comprehensive overview of the field. Accepting to coordinate such focus issues represents a great service to OSA and I want to express my special thanks to Roland Winston for his hard work and for accepting to serve as Associate Editor.

The implementation of the mission of a journal like *Energy Express* relies on the service of the members of OSA who are willing to serve as Associate Editors and as reviewers. Their dedication and the quality of their work are critical to our success, and in maintaining the highest standards of quality of OSA publications at a time when the number of submitted publications is growing exponentially. My gratitude goes to them and I hope that their scholarly rigor will help us create the leading source of scientific publications on optical technologies related to energy research and technological innovations. Finally, I sincerely hope that the leading optical scientists and engineers will consider *Energy Express* as their number one choice to disseminate rapidly to the scientific community their latest and highest-quality discoveries that address the energy challenge.

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