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# PROCEEDINGS OF SPIE

## ***Photonic Crystal Materials and Devices IX***

**Hernán R. Míguez**  
**Sergei G. Romanov**  
**Lucio Claudio Andreani**  
**Christian Seassal**  
*Editors*

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# Introduction

Since its blooming in the late eighties, research on photonic crystals has grown steadily to become a settled field in which scientists from very diverse areas participate actively. This interdisciplinary atmosphere could be experienced during the 2010 edition of the Photonic Crystal Materials and Devices conference held in Brussels, in which physicists, chemists, and engineers met to share and debate about their latest results. As it has been the case in previous editions of the conference, an adequate balance between works focused on the theoretical description of materials and devices and their actual realization and characterization was achieved. Among the wide diversity of topics covered by the different contributors, several works belonging to well-established research areas within the field could be identified, such as self-assembled photonic crystals or light propagation in photonic crystal waveguides. However, some of the new subjects introduced in the call for the first time attracted a good number of works as well as the attention of numerous participants in this Photonics Europe event, as it could be seen during the presentations. New growing research areas such as photonic crystals for photovoltaic or sensing applications, or the analysis of the effect of disorder on light propagation in photonic crystal materials or devices, have become high impact ones within the field and will find certainly their room in future editions of the conference.

## **Novel perspectives of photonic crystal materials**

Recent advances in both already widespread as well as novel methods for the preparation of photonic crystals were highlighted in the conference. For instance, the growing interest and dissemination of the application of two-photon absorption-based laser scribing techniques to the field was illustrated by the work of the Foundation for Research and Technology (Greece). The introduction of well known dyes, such as Rhodamines, in the novel form of solid films in photonic crystals for sensing applications, as developed in the Institute of Materials Science of Seville, is also an example of the introduction of new synthetic routes of great potential.

The maturity of the field of self-assembled photonic crystals made out of colloidal particles was also highlighted by a number of presentations, many of them focused on the analysis of complex anomalous optical behavior, like the invited talk presented by Mikhail Limonov on the observation of Fano resonances. Although still far from applications, self-assembled photonic crystals continue to provide a platform for fundamental research on subjects such as non-linear effects, slow light enhancement of emission, or amplified optical absorption in periodic structures.

The opportunities offered by the command over the type of disorder present in colloidal based structures in terms of the control over the photon propagation was revealed by Diederik Wiersma in his talk about Levy flight of photons. From a totally different perspective, the importance of taking into account disorder and imperfections in the description of wave propagation in

photonic crystal waveguides was evidenced by a couple of invited presentations by Philippe Lalanne and Alfredo De Rossi, which generated an exciting and lively debate. Besides disorder effects, the very precise control of light propagation in photonic crystal slab waveguides and of light-matter interaction in nanocavities was also emphasized in several presentations, especially in the talk by Eiichi Kuramochi from NTT-Tokyo on dynamically tuned photonic crystal cavities.

### **Prospective applications**

In terms of applications, the conference covered the exciting subject of novel biological and chemical sensing devices based on multifunctional photonic crystal structures, a field that could only evolve due to the convergence of scientists of very different areas of expertise. As confirmed by the exciting presentations on one- and two-dimensional photonic crystal based sensing devices given by Cecile Jamois and Bettina Lotsch, its potential is enormous and still to be fully explored. Along with the high sensitivity and versatility that can be achieved, the relevance of controlling the physico-chemical properties of the internal photonic crystal surfaces in order to endow it with a selective response to the desired environmental changes or to the presence of a specific analyte became evident during the discussions, the interdisciplinary character of this research being highlighted even more.

We should also remark the great interest generated by the latest results on the application of photonic crystals to photovoltaics, be them experimental or theoretical and focused on the design and optimization. The possibility photonic crystals offer to improve the solar-to-electric power conversion efficiency by enhancing optical absorption through phenomena of light localization, slow propagation or optimum coupling to the cell structure, certainly generates great expectation. Current state of the art allows one foreseeing that new exciting results will be achieved in the next years.

Light emitting devices also deserved a great deal of interest during the conference, with relevant examples of amplification effects being shown on the luminescence from active materials, such as, for instance, erbium embedded in silicon photonic crystals. The enhancement effect on processes such as Raman scattering was also discussed. Novel passive optical elements, in which the highly anisotropic character of light propagation in photonic crystals can be put into practice, were also present in the conference.

In summary, the 2010 edition of the Photonic Crystal Materials and Devices conference (7713) provided an exciting and lively environment for scientific discussion and collaboration. The quality of the works presented, the interest generated in the participants, and the presence of many young researchers from a wide range of countries lead us to confirm the good health of the field and ensures its continuity.

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