1-1-2012

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Recommended Citation

Ballato, J. and Abouraddy, A. F., "Feature issue introduction: specialty optical fibers" (2012). *Faculty Bibliography 2010s*. 2264.
https://stars.library.ucf.edu/facultybib2010/2264

Feature issue introduction: specialty optical fibers

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Abstract: *"For groundbreaking achievements concerning the transmission of light in fibers for optical communication."* With this citation, the Nobel Committee bestowed the 2009 Nobel Prize in Physics to Dr. Charles Kao and validated the global importance of optical fibers. That said, technological demands march on and the applications in which optical fibers are employed continue to expand. Further, both existing and emerging applications are requiring greater performance and functionality, beyond those associated with telecommunications, from the enabling optical fibers; and so it is timely to offer this special issue that compiles recent advances in specialty optical fibers.

OCIS codes: (160.2290) Fiber materials; (060.2290) Fiber materials; (060.2310) Fiber optics.

References and links

1. D. Richardson, J. Nilsson, and A. Clarkson, "High power fiber lasers: current status and future perspectives [Invited]," J. Opt. Soc. Am. B **27**(11), B63–B92 (2010).
2. M. Fermann and I. Hartl, "Ultrafast fiber laser technology," IEEE J. Sel. Top. Quantum Electron. **15**(1), 191–206 (2009).
3. S. Jackson, "Towards high-power mid-infrared emission from a fibre laser," Nat. Photonics **6**(7), 423–431 (2012).
4. X. Bao and L. Chen, "Recent progress in distributed fiber optic sensors," Sensors (Basel) **12**(7), 8601–8639 (2012).
5. Z. Wang and N. Chocat, "Fiber-optic technologies in laser-based therapeutics: threads for a cure," Curr. Pharm. Biotechnol. **11**(4), 384–397 (2010).
6. Ł. Sójka, Z. Tang, H. Zhu, E. Bereś-Pawlik, D. Furniss, A. B. Seddon, T. M. Benson, and S. Sujecki, "Study of mid-infrared laser action in chalcogenide rare earth doped glass with Dy^{3+}, $Pr^{3+}$and Tb^{3+}," Opt. Mater. Express **2**(11), 1632–1640 (2012).
7. C. Conseil, J.-C. Bastien, C. Boussard-Plédel, X.-H. Zhang, P. Lucas, S. Dai, J. Lucas, and B. Bureau, "Te-based chalcohalide glasses for far-infrared optical fiber," Opt. Mater. Express **2**(11), 1470–1477 (2012).
8. N. Tolstik, E. Sorokin, V. Kalashnikov, and I. T. Sorokina, "Soliton delivery of mid-IR femtosecond pulses with ZBLAN fiber," Opt. Mater. Express **2**(11), 1580–1587 (2012).
9. S. Morris, T. Hawkins, P. Foy, J. Hudson, L. Zhu, R. Stolen, R. Rice, and J. Ballato, "On loss in silicon core optical fibers," Opt. Mater. Express **2**(11), 1511–1519 (2012).
10. R. He, P. Sazio, A. Peacock, N. Healy, J. Sparks, M. Krishnamurthi, V. Gopalan, and J. Badding, "Integration of gigahertz-bandwidth semiconductor devices inside microstructured optical fibres," Nat. Photonics **6**(3), 174–179 (2012).
11. J. Ballato, T. Hawkins, P. Foy, B. Yazgan-Kokuoz, C. McMillen, L. Burka, S. Morris, R. Stolen, and R. Rice, "Advancements in semiconductor core optical fiber," Opt. Fiber Technol. **16**(6), 399–408 (2010).
12. H. Ahmad, K. Thambiratnam, M. C. Paul, A. Z. Zulkifli, Z. A. Ghani, and S. W. Harun, "Fabrication and application of zirconia-erbium doped fibers," Opt. Mater. Express (to be published).
13. W. Blanc, C. Guillermier, and B. Dussardier, "Composition of nanoparticles in optical fibers by secondary ion mass spectrometry," Opt. Mater. Express **2**(11), 1504–1510 (2012).
14. W. Blanc, D. Dussardier, and M. Paul, "Er-doped oxide nanoparticles in silica-based optical fibers," Phys. Chem. Glasses **A50**, 79–81 (2009).
15. T. Lindstrom, E. Garber, D. Edmonson, T. Hawkins, Y. Chen, G. Turri, M. Bass, and J. Ballato, "Spectral engineering of optical fiber preforms through active nanoparticle doping," Opt. Mater. Express **2**(11), 1520–1528 (2012).
16. C. Kucera, B. Kokuoz, D. Edmondson, D. Griese, M. Miller, A. James, W. Baker, and J. Ballato, "Designer emission spectra through tailored energy transfer in nanoparticle-doped silica preforms," Opt. Lett. **34**(15), 2339–2341 (2009).

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17. P. Dragic, J. Ballato, A. Ballato, S. Morris, T. Hawkins, P.-C. Law, S. Ghosh, and M. C. Paul, "Mass density and the Brillouin spectroscopy of aluminosilicate optical fibers," Opt. Mater. Express **2**(11), 1641–1654 (2012).
18. O. I. Medvedkov, S. A. Vasiliev, P. I. Gnusin, and E. M. Dianov, "Photosensitivity of optical fibers with extremely high germanium concentration," Opt. Mater. Express **2**(11), 1478–1489 (2012).
19. G. Violakis, N. Aggarwal, and H. G. Limberger, "Stress changes in H_2-loaded SMF optical fibers induced by cw-Ar^+ 244 nm irradiation," Opt. Mater. Express **2**(11), 1490–1495 (2012).
20. N. Troy, C. W. Smelser, and D. M. Krol, "Role of hydrogen loading and glass composition on the defects generated by the femtosecond laser writing process of fiber Bragg gratings," Opt. Mater. Express **2**(11), 1663–1670 (2012).
21. R. Kostecki, H. Ebendorff-Heidepriem, C. Davis, G. McAdam, S. C. Warren-Smith, and T. M. Monro, "Silica exposed-core microstructured optical fibers," Opt. Mater. Express **2**(11), 1538–1547 (2012).
22. S. Karbasi, T. Hawkins, J. Ballato, K. W. Koch, and A. Mafi, "Transverse Anderson localization in a disordered glass optical fiber," Opt. Mater. Express **2**(11), 1496–1503 (2012).
23. S. V. Sergeyev, "Fiber Raman amplification in a two-scale spun fiber," Opt. Mater. Express (to be published).

The utility of optical fibers continues to expand as applications, such as those associated with amplifiers, lasers, and sensors [1–5], proliferate. Such specialized purposes are imposing greater demands on the properties and performance of optical fibers and, in response, novel fiber materials and designs are being aggressively developed to meet these needs. This special issue is one attempt to capture some state-of-the-art exemplars in three thematic areas: (1) infrared glass optical fibers, (2) nanocomposite optical fibers, and (3) novel properties and processing of oxide glass optical fibers. Many of the papers contained herein expand on work originally presented at the Specialty Optical Fiber topical meeting held at the Optical Society of America's Advanced Photonics Congress in Colorado Springs, Colorado, United States, from June 17–22, 2012.

Infrared glass optical fibers have been of interest for several decades, but are enjoying something of a renaissance at present given the growing need for infrared transparency associated with chemical and biological agent sensing, infrared countermeasures, and thermal imaging, to name just a few. Specific to this feature issue, chalcogenide and fluoride glass fibers, as well as more recently developed crystalline semiconductor-core optical fibers, are reported. Sójka *et al.* [6] discuss actively doped chalcogenides and their prospective performance as mid-IR fiber-based lasers and amplifiers. Conseil *et al.* [7] investigate tellurium-based chalcohalide fibers that possess enhanced thermal stability and their use at long wavelength infrared wavelengths of interest for astronomical applications. Tolstik *et al.* [8] theoretically and experimentally treat soliton propagation in fluoride glass optical fibers. Morris *et al.* [9] build off of recent work, principally in the United States and the United Kingdom [10,11], on glass-clad crystalline semiconductor core optical fibers and identifies sources of loss and potential mitigation schemes that presently limit the wider applicability of these fibers.

Nanocomposite fibers, at least as categorized here, refer to optical fibers that possess nanoscale heterogeneities that are purposefully induced in order to beneficially impact performance. Ahmad *et al.* [12] report on silica-based optical fibers in which zirconia (ZrO_2)-rich nanophases are separated out, into which erbium dopants partition and enhance their performance. Blanc *et al.* [13] expand on previous work in which nanoparticles are formed in the core of silicate fibers [14] and studies in detail their composition. Such information is important for the subsequent optimization of the fibers optical properties. Lindstrom *et al.* [15], also building off prior work [16], investigate the influence of (rare-earth-doped) nanoparticle chemistry on spectroscopic properties of the resultant nanoparticle-doped silica glass preforms showing that local chemical effects indeed can have strong influences on the performance of the bulk glass.

Given the commercial success of silica optical fibers, it is not surprising that the largest number of contributions to this issue fall under the general topic of oxide glass fibers. That said, there is an interesting diversity of offerings including the processing and properties of aluminosilicate fibers, germanosilicate fibers, porous silica fibers, hydrogen-loaded fibers, and microstructured optical fibers. Specifically, Dragic *et al.* [17] provide a detailed treatment of the acoustic and Brillouin properties of aluminosilicate fibers. Medvedkov *et al.* [18] treat high germania (GeO_2) content fibers and their photosensitivity. Violakis *et al.* [19] also are

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concerned with photosensitive fibers and study in depth the influence of ultraviolet (244 nm) irradiation on stress in hydrogen-loaded silica fibers. In a complementary work, Troy *et al.* [20], H-loaded fibers are evaluated for the defects created under femtosecond laser irradiation. Kostecki *et al.* [21] present results on novel microstructured silica optical fibers possessing exposed cores, which are of interest for enhanced fiber-based sensors. Such air/silica structured fibers take on a whole new meaning in Karbasi *et al.* [22], who treat light propagation in a porous silica fiber confined by the transverse Anderson localization mechanism. Lastly, Sergeyev [23] demonstrates theoretically that control over a two-scale spun fiber profile may enable stabilization of the state of polarization along the fiber while maintaining high Raman gain and simultaneously low polarization mode dispersion and polarization dependent gain.

It is our hope that these examples of recent innovations in specialty optical fibers spur continued excitement and interest in our field, especially amongst the next generation of optical materials scientists and engineers.

Acknowledgments

The “special” in “Special Issue” conventionally refers to the given thematic focus. However, as those directly involved know well, “special” also refers to the accelerated reviewing and publication timelines while maintaining high-quality peer review. We (JB and AA) wish to thank the reviewers, who always remain nameless (but we know who you are), and the OSA staff who kept the process moving—always in a professional (and diplomatic) manner.