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Optical Nonofibers a Comprehensive Review

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Abstract—**Optical nanofibers, defined as diet waves, represent a revolutionary diameter of a diameter or in nanophotonics compared to the wavelength of the directed light, which bridge the bridge between classic fiber optics with nanoskal light manifies. This extensive review examines basic principles, production techniques, unique properties and various applications of optical nanofibers in many subjects. As his installation for quantum optics, biosoying and their current role in particle manipulation, optical nanofibers have developed in versatile equipment that utilizes strong explosive areas spread across the surface of the fiber. We analyze recent advances in production methods, including flame brushing and chemical trapping techniques, and discussing the theoretical structure that controls light proliferation in Twaywental waves. Reviews include large applications including inguinal sensitivity with outstanding sensitivity, nuclear light interactions, particle catching and manipulation system, including quantum optics platforms and emerging areas such as emerging areas such as Optomacics and non-linear optics. Current challenges, including scalability, environmental and power handling limits, are seriously investigated with future opportunities for this rapidly developed field. This review serves as a comprehensive resource for researchers and engineers working at the intersection of fiber optics, nanophotonic and quantum technologies.**

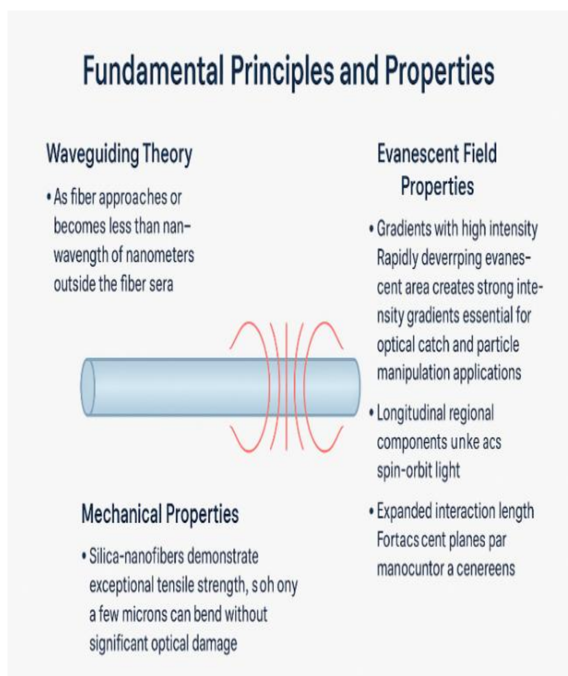
I. INTRODUCTION

The area of optical nanofibers has emerged as a transformative area in nanophotonic, which provides unique opportunities to manipulate light lights on nanoscale, and maintain practical benefits of fiber optic systems. Optical nanofibers, also known as optical nanovir or under wave length fibers, are characterized by their ultra-shade diameter, which usually ranges from dozens to hundreds of nanometers-oxy under the optical well-friendly. This unique geometry enables extraordinary optical properties that have opened new paths for scientific research and technical applications in different fields.

The basic appeal of optical nanofibers lies in their ability to limit the lighting in a very small cross - sectional region, while maintaining a low circulation deficit, a combination previously unattended with traditional photonic structures. Unlike colleagues in bulk fiber, the optical nanofibre mode supports significantly disorganized field components that are expanded far beyond the physical boundaries of the wave, enabling direct interactions between the directed light and the surroundings.

Since the beginning of the 2000s, the flame brush method has enabled the production of high -quality optical nanofibers with control-gender dimensions and extraordinary optical properties to develop reliable construction techniques, especially silica fabrics. These advances have catalyzed research in many subjects, from the basic study of lighting room interactions to sensing, quantum optics and practical applications in particles manipulation

II. FUNDAMENTAL PRINCIPLES AND PROPERTIES



2.1Waveguiding Theory:

The optical properties of nanofibers are quite distracted by traditional fiber optics due to their deeper dimensions. As the fiber approaches the diameter or becomes less than the wavelength of the guided light, the effective mode area can actually grow because the diameter decreases, with the most optical power spread outside the physical fiber area.

For silica -nanofibers in the air, large refractive index contrasts (N_CORE, 1.46, N_CLADING = 1.0) result in high numeric aperture and strong light prison. However, tissue behavior is fundamentally converted to the subway well deeper rule, requires full vectoral lectromagnetic modeling instead of traditional fibers, a valid scallery convenience of traditional fibers.

2.2Evanescent Fiend Properties:

The defined feature of optical nanofibers is their sufficient incurable area that extends to hundreds of nanometers outside the fiber surface. This unfortunate area shows many unique properties:

Gradients with high intensity: Rapidly overdue incurable area creates strong intensity gradients that are essential for optical catch and particle manipulation applications.

Longitudinal regional components: Unlike traditional fibers, Nanofibre supports important longitudinal electric field components that enable new interactions such as spin-arbitious light.

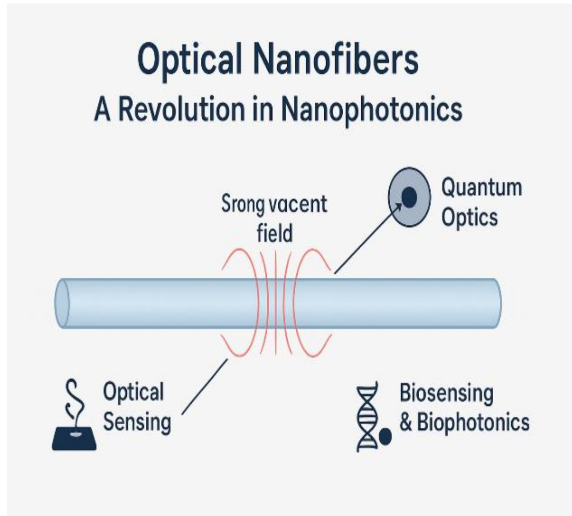
Expanded interaction length: The unfortunate area provides extended length of interaction for applications that require fluorescent coupling, which is achieved with concentrated free space rays.

2.3Mechanical Properties

Optical nanofibers show remarkable mechanical properties that complement their optical properties. Silica -nanofibers demonstrate exceptional tensile force, so only a few microns can bend without significant optical damage. This mechanical flexibility enables the manufacture of compact resonators and complex photonic circuits on the microsal.

III. OPTICAL NANOFIBERS: A REVOLUTION IN NANOPHOTONICS

The document examines the transformation role of optical nanofibers (ONF) in nanophotonics. OnF is ultra-thin fibers, usually with diameter ranging from dozens to hundreds of nanometers, enabling accurate manipulation of light in nanoscale, and maintains the practical benefit of traditional fiber optic systems. Their ability to limit the lighting in extremely small areas and generate strong -sighted areas has opened new opportunities in areas such as quantum optics, optical sensing, particle manipulation and basic light -matter interactions.



Progress in construction methods, especially flame brashing techniques, COO-laser loss and chemical catches, have made it possible to produce low-loss nanofibers, with high transport with reliable performance. These fiber light mats get skill in increasing link, do not support -linear photonic effects and enable very sensitive biosying applications.

While challenges remain, including fragility and environmental sensitivity, optical nanofibers are ready to revolutionize the next generation of photonic technologies. Their integration into quantum communication systems, lab-on-fiber diagnostics and hybrid nanophotonic devices highlight their ability as a cornent technology that bridges classic fiber optics with new quantum and nanoskala applications.

IV. PRODUCTION TECHNOLOGY

4.1 Flame Brushing Method

The flame brushing method, also known as heat-end-pull technology, is the most widespread approach to standard silica optic fibers to create high-quality optical nanofibers. In this process, a conventional fiber is threaded between two high -colored translation stages. A narrow, controlled flame is usually directed in the middle of a hydrogen oxygen burner from the fiber, while the two loops are separated at a predetermined speed. The fiber softens into the warm area, and a thin, underwaving-buttable waist as a result of careful stress. By controlling the draft speed, flame length and temperature properly, researchers achieved adiabetic tapered profiles, and reduced optical damage due to modus coupling. As a result, Nanofiber has strong transmission (often> 95%), mechanical uniformity and highly reproducible diameter, under dozens of nanometers. Ediyabatic control of this method is important because sudden infection can spread light and introduce defects. The benefits of the flame brush method are its relapse, scalability for long-term loser and production of ultra-soft surfaces required for interaction with little loss in sensing and quantum optics applications.

4.2 Chemical Etching

Chemical cuts provide an alternative production strategy for nanofiber, especially useful for making sharp fiber tips and under wave length structures without mechanical strain. This method involves dipping an optical fiber in hydrofluoric acid (HF), which dissolves selective silica glass. The cash price depends on HF concentration, temperature and exposure time.

Typically, a two-stage procedure is used: a high-verine solution begins to decrease in a rapid diameter, then a Miller concentration is achieved in gradually, controlled thin-thin-thin nanofibers (often called optical nanofiber tips or ONS). By masting parts of fiber with chemically resistant coating, only specific areas are exposed to caravation, which enables local nanofiber formation. A large distribution tip is accurate, reproducible control of geometry, which is important for applications such as optical microscopy and single-lean sensation near high resolution. Chemical cuts are less sensitive to mechanical vibrations or equipment accuracy than methods of drawing thermal, making it suitable for integration into specialized geometry or microfluidic devices.

4.3 Parallel construction

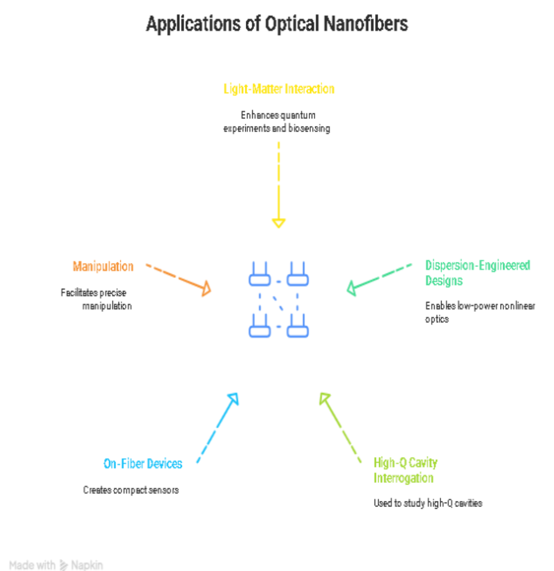
Parallel construction addresses the bottleneck for scalability in one-fiber nanofiber production techniques, aimed at producing uniform nanofibers at the same time. This method typically involves packing several optical fibers and submitting them during the synchronization of tension and heating, which often uses a wide electric heater or multiple flame flambs. Careful design ensures that each fiber experiences similar thermal gradients, draws speed and stress, resulting in constant tapered profiles and diameter in all fiber in the lot. Recent research shows the viability of the production of 20 nanofibers in parallel, and maintains each high transfer and dimensional uniformity. Parallel construction reduces the time and labor required for large -scale experiments or unit mounting, causing large -scale distribution in sensing, telecommunications and medical diagnosis. However, it requires careful control to reduce the variation of fiber-to-fiber and sophisticated layouts that adjust the difference in fiber positioning and heating deformity. As research continues, parallel construction techniques promise to enable nanofiber-based photonic systems and commercialization of large integrated sensor arrays.

4.4 Electrode for polymer nanofibers

Electrical playing represents the modern construction method for polymer -based nanofibers, its versatility, scalability and nanofiber is precious for control of morphology. When Elec trooping, a polymer solution is loaded or melt in a syringe with a metal needle attached to a high voltage power supply. When the tension is applied, electrostatic forces exclude the stress of the surface, excludes a thin -jet of polymer against an earthed collector. When the solvent evaporates or is a melted cool route, fixed nanofibers accumulate in mats or lined matrices on the collector. Parameters such as polymer concentration, voltage, feed speed, collector distance and ambient positions such as 10 nanometers (which may be small as 10 nanometers) are well set to regulate adjustment, porceity and surface structure. Electrical playing produces ultra-long nanofibers with a very high surface-to-volume ratio, which is beneficial for sensing, filtration, biomedical scaffolding and tissue technique. It also enables simple functionalization - built -in nanopartans, colors or biomolecules in or inside the surface of the fiber. The simplicity and compatibility of the method with many polymers makes it invaluable to make the flexible, bio -rich and multicultural photonic nanodehouses

V. APPLICATIONS OF OPTICAL NANOFIBERS

This document examines various applications of optical nanofibers (ONF), which highlights their unique properties that enable progress in different regions. We will take into account how maximum light material interaction on the surface of ONFS provides quantum experiments and biosence, how their spreading motor design enables low power non-linear optics, how to use high quo cavities, how to use fiber equipment for compact sensors.

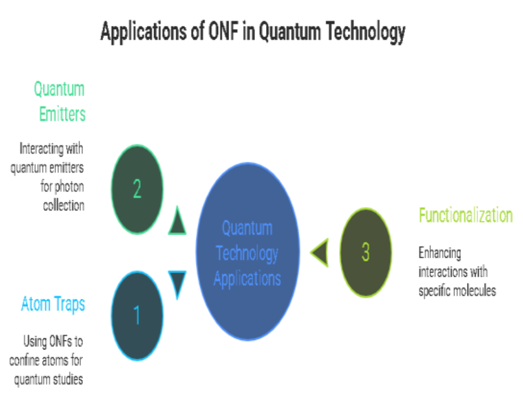


Maximum Light-Matter Interaction at the Surface

Optical nanofibers, especially at the waist, provide a unique platform to increase the light mast interaction. This stems from the fact that an important part of the directed light spreads outside the fiber core, creating a strong surprising area on the surface. This intensive interaction opens the doors for more applications, including quantum optics and bioscience.

5.1Quantum Applications:

The strong side area of an ONF can be used to interact with individual atoms or quantum broadcasters. In case of atoms near the OnF mid, the interaction between the guided photons and atoms is maximized. This allows atoms for effective light coupling, which enables a nuclear network and the study of the basic quantum phenomenon.



Atomic networks: On Fs can be used to make optical bipolar yarn for neutral atoms. The strong shield in the unfortunate area attracts atoms to the surface and limits them in a small amount. These yarns can be used to study cold atoms, make quantum simulation and create quantum memories.

Quantummitors: OnFs can also be used to interact with other quantum emissions, such as quantum dots or nitrogen tissue (NV) centre in diamond. Allows effective collection of photons sent out of a strong coupling semites between ONF and emitter, enabling the development of single photon sources and quantum sensors.

Functionalization: Onf midje can be functional with specific molecules or materials to increase the interaction with target atoms or quantum broadcasters. This enables accurate control over interaction and enables the production of similar quantum units.

The strong evanescent field of an ONF can be used to interact with individual atoms or quantum emitters. By positioning atoms near the ONF waist, the interaction between the guided photons and the atoms is maximized. This allows for efficient coupling of light to the atoms, enabling the creation of atom traps and the study of fundamental quantum phenomena.

Atom Traps: ONFs can be used to create optical dipole traps for neutral atoms. The strong gradient of the evanescent field attracts atoms towards the ONF surface, confining them in a small volume. These traps can be used to study cold atoms, perform quantum simulations, and create quantum memories.

Quantum Emitters: ONFs can also be used to interact with other quantum emitters, such as quantum dots or nitrogen-vacancy (NV) centres in diamond. The strong coupling between the ONF and the emitter allows for efficient collection of photons emitted by the emitter, enabling the development of single-photon sources and quantum sensors.

Functionalization: The ONF waist can be functionalized with specific molecules or materials to enhance the interaction with the target atoms or quantum emitters. This allows for precise control over the interaction and enables the creation of tailored quantum devices.

Biosensing Applications:

The strong light-material interaction on the onf surface also makes it an ideal platform for bioscience. When biomolecules bind to the surface, they change the refractive index in the area around the fiber, which in turn affects the spread of light through the fiber. By monitoring these changes, it is possible to detect the presence of specific biomolecules with high sensitivity.

Label-free detection: OnF-based biosensor can detect biomolecule without the need for fluorescent lamps. This simplifies the detection process and the label avoids possible intervention.
High sensitivity: Strong light-Materi interaction makes it possible to detect small changes in the refractory index, which is able to detect low concentrations of biomolecules.
OnF-based biosensors in real time: OnF-based biosensors can provide real-time monitoring of biomolecular interactions, which provides the opportunity for studies of dynamic processes.
Functionalization: Onf -surface can be functional for capturing target biomolecules functionally with specific antibodies or other bonding molecules. This ensures that only desired molecules are detected and the specificity of the sensor is improved.
5.2Non-linear optics with low effect:
Optical nanofibers, especially when spreading engines, provide an excellent platform to achieve effective non-linear optical interactions at low electrical levels. The tight imprisonment of light in the nanofiber does not improve the -linear effect, while the spread allows to match the engineering phase, which is important for effective non -linear conversion.
Spreading technique: It is possible to tailor the spreading properties by controlling the geometry of the ONF carefully. This enables phase matching of different wavelengths, which are necessary for effective non-linear processes such as four-wave mixture (FWM) and supercontinuum generation (SCG).
Four -Waving Mix (FWM): FWM is a non -linear process in which two pump photons interact to generate a signal photon and an idollar photon. OnFs can be used to achieve effective FWM at low electrical levels, which can enable applications such as optical parametric amplification and conversion of wavelength.
Supercontinuum Generation (SCG): SCG is a process where a small light pulse is widespread in a wide range due to non -linear interaction. OnFs can be used to generate broadband Supercon Tua with low input power, which can enable applications such as optical cooresce tomography and frequency metrology.
Applications: Low-power-free non-powerful non-useful optics using ONFs contain applications in various fields, including optical communication, spectroscopy and imaging.
5.3High-Q Guvas interrogated:
Optical nanofibers can be used in the form of coupling buses to question high out optical cavities. By placing an ONF near a high quo cavity, the light can be added effectively and out of the cavity. This enables accurate control over cavity mode and the cavity enables the study of quantum electrodynamics (CQED).
Coupling simply: OnF acts as a wave that transports light and light from the cavity. The unfortunate area with ONF interacts with cavity mode, which allows for skilled coupling.
High-Q cavity: High priests are optical resonators that store the light for a long time. They are used in different types of applications, including laser, sensors and quantum formation treatment.
Guha Quantum Electrogenamics (CQED): CQED is a study of interaction between light and fabric in a cavity. Onfer can be used to study CQED events, such as strong links between atoms and cavities.
Applications: There are applications in different fields to interrogate cavities with high quo with ONF, including quantum optics, sensing and metrology.
5.4On-Fiber Devices:
Optical nanofibers can be used to make compact devices on fiber, such as Nano-Fiber Brag Grags (FBG) and interferometer. These devices can coins directly on the OnF mid, which makes very integrated and short sensors.
Nano-FBG: Nano-FBG is periodic structures inscribed on the onf mids that reflect light on a specific wavelength. They can be used as filters, mirrors and sensors.
Interferometer: Interferometer is the optical device that divides a beam of light into two or more squares and then add them again. One of the paths will interfere with changes in optical track length, which can be used to measure different parameters, such as temperature, stress and refraction index.
Compact sensor: On fiber devices can be used to make compact and very sensitive sensor. The small size of ONF enables integration in narrow places, while strong light material increases the sensitivity of the interaction sensor.
Applications: On fiber units contain applications in different fields, including environmental monitoring, biomedical sensing and structural health monitoring.
5.5Manipulation :
Optical nanofibers can be used to manipulate small objects, such as nanos and biological cells. Using steep waves or polarization control, it is possible to create an optical network that can catch and move these objects.
Standing waves: Standing waves are formed when the lights have two counter -propagation rays. The intensity of the permanent wave varies from time to time, making a variety of optical netting.

Polarization control: Light polarization can be used to control the size and orientation of the optical network.
Trap Deletion: It is possible to create optical trap matrices using multiple light rays. These matrices can be used simultaneously to manipulate many objects.
Applications: Manipulation of small items with ONFs contains applications in different areas, including microfluidics, cell biology and nanotechnology.

VI. FUTURE OUTLOOK

The destiny of optical nanofibers (ONFs) lies in their integration with rising materials and scalable fabrication methods with a purpose to enlarge both overall performance and practicality. Hybrid systems that combine ONFs with plasmonic nanostructures, two-dimensional materials together with graphene and transition steel dichalcogenides, and high-Q micro resonators are expected to noticeably decorate mild–matter interactions, permitting extremely-touchy detection and green nonlinear tactics. Advances in protecting coatings, encapsulation, and biocompatible substances will enhance their mechanical robustness and environmental balance, establishing the door to reliable deployment in biomedical diagnostics and in vivo sensing. In quantum science, ONFs are poised to become essential components of quantum networks, acting as efficient interfaces between single photons and quantum emitters such as atoms, quantum dots, and color centers. Their ability to transmit light with high efficiency and minimal loss makes them ideal for scalable quantum communication and information processing. Meanwhile, in applied photonics, ONFs are expected to play an increasing role in portable sensor platforms, environmental monitoring and lab-on-fiber systems, where their compactness and fiber compatibility are major advantages.
As manufacturing technologies mature and integration strategies are developed, ONFs are poised to evolve from primarily research devices to commercially viable technologies. Their unique balance between nanoscale sensitivity and fiber-based practicality positions them to drive innovation in sensing, communications and quantum information science for decades to come.

VII. CONCLUSION

Optical nanofibers (ONFs) have emerged as one of the most versatile and powerful equipment in cutting-edge photonics, bridging the gap among traditional optical fibers and nanoscale light–remember interplay platforms. By tapering popular optical fibers down to diameters similar to or smaller than the wavelength of mild, ONFs confine and manual light in a regime in which a massive fraction of the optical electricity is living inside the evanescent discipline outside the fiber. This unique belongings enables unparalleled sensitivity to the surrounding surroundings and allows efficient coupling to atoms, molecules, and nanostructures.
The fundamental benefit of ONFs lies of their capacity to combine the robustness and connectivity of traditional fiber optics with the nanoscale interplay strengths generally associated with integrated photonic gadgets. Their fabrication, regularly done through flame-brushing or laser-heated tapering, is particularly sincere and likeminded with present fiber structures, making them notably on hand for laboratory and carried out settings. Despite their nanoscale dimensions, ONFs can preserve low propagation losses while fabricated under adiabatic conditions, making sure green transmission while exposing mild to the external medium.
Applications of ONFs span a huge style of disciplines. In sensing, they provide label-loose detection of refractive index modifications, biomolecules, and chemical species with top notch sensitivity, often all the manner all the way down to single-molecule tiers. In quantum optics, ONFs permit strong coupling between guided modes and bloodless atoms or quantum emitters, paving the manner for scalable quantum communication and records processing. Their capacity to help nonlinear tactics, which includes supercontinuum era and four-wave blending, similarly extends their software into spectroscopy and ultrafast photonics. Biomedical studies has additionally benefited from ONFs, in which their minimally invasive geometry lets in probing of tissues and microfluidic environments with excessive spatial choice.
Nevertheless, demanding situations continue to be. ONFs are robotically fragile and notably sensitive to environmental perturbations which include humidity, temperature fluctuations, and surface infection. Addressing those troubles calls for advances in protecting coatings, hybrid integration with other nanomaterials, and scalable fabrication techniques. Future studies is probably to awareness on combining ONFs with plasmonic systems, -dimensional materials, and micro resonators to beautify sensitivity, tailor dispersion, and make bigger capability.
In precis, optical nanofibers constitute a transformative platform in photonics, presenting a

completely unique stability of fiber compatibility, nanoscale interplay, and huge application potential. As fabrication strategies mature and hybrid approaches evolve, ONFs are poised to play a imperative function in subsequent-generation era for sensing, quantum technological know-how, and bio photonics.

REFERENCE

[1] Tong, L., Gattass, R. R., Ashcom, J. B., He, S., Lou, J., Shen, M., Mazur, E. (2003). Subwavelength-diameter silica wires for low-loss optical wave guiding. Nature, 426, 816–819.

[2] Tong, L., Lou, J., & Mazur, E. (2004). Single-mode guiding properties of subwavelength-diameter silica and silicon wire waveguides. Optics Express, 12(6), 1025–1035.

[3] Tong, L., & Sumetsky, M. (Eds.). (2010). Subwavelength and Nanometer Diameter Optical Fibers. Springer.

[4] Brambilla, G. (2010). Optical fibre nanowires and microwires: a review. Journal of Optics, 12(4), 043001.

[5] Brambilla, G., Finazzi, V., & Richardson, D. J. (2004). Ultra-low-loss optical fiber nanotapers. Optics Express, 12(10), 2258–2263.

[6] Spillane, S. M., Pati, G. S., Salit, K., Hall, M. T., Kumar, P., Beausoleil, R. G., & Knight, J. C. (2003). Ultralow-threshold Raman laser using a spherical dielectric microcavity. Nature, 415, 621–623.

[7] Morrissey, M. J., Deasy, K., Frawley, M., Kumar, R., Prel, E., Russell, L., Nic Chormaic, S. (2009). Spectroscopy, manipulation and trapping of neutral atoms, molecules, and other particles using optical nanofibers: a review. Sensors, 9(5), 3799–3826.

[8] Nayak, K. P., & Hakuta, K. (2010). Photonic crystal formation on optical nanofibers using femtosecond laser ablation. Optics Express, 18(6), 6131–6140.

[9] Warken, F., Rauschenbeutel, A., & Vetsch, E. (2007). Optical nanofibers for atom trapping. Optics Express, 15(19), 11952–11958.

[10] Vetsch, E., Reitz, D., Sagué, G., Schmidt, R., Dawkins, S. T., & Rauschenbeutel, A. (2010). Optical interface created by laser-cooled atoms trapped in the evanescent field surrounding an optical nanofiber. Physical Review Letters, 104(20), 203603.

[11] Le Kien, F., Balykin, V. I., & Hakuta, K. (2004). Atom trap and waveguide using a two-color evanescent light field around a subwavelength-diameter optical fiber. Physical Review A, 70(6), 063403.

[12] Le Kien, F., Liang, J. Q., Hakuta, K., & Balykin, V. I. (2004). Field intensity distributions and polarization orientations in a vacuum-clad subwavelength-diameter optical fiber. Optics Communications, 242(4–6), 445–455.

[13] Ward, J. M., & Nic Chormaic, S. (2006). Optical resonators and microcavities in optical nanofiber systems. Applied Physics B, 86, 497–503.

[14] Fujiwara, H., Takeuchi, S., & Sasaki, K. (2006). Optical nanofiber-based cavity QED. Physical Review Letters, 97(5), 053002.

[15] Brambilla, G., Koizumi, F., Feng, X., & Richardson, D. J. (2007). Compound-glass optical nanowires. Electronics Letters, 43(4), 198–199.

[16] Sumetsky, M. (2004). Nanophotonic of optical fibers. Journal of Lightwave Technology, 22(1), 345–352.

[17] Lou, J., Tong, L., & Ye, Z. (2005). Modeling of silica nanowires for optical sensing. Optics Express, 13(6), 2135–2140.

[18] Wu, X., Ward, J. M., & Nic Chormaic, S. (2010). Ultralow-loss optical nanofibers for sensing applications. Applied Physics B, 99, 47–51.

[19] Kumar, R., Gokhale, S., & Nic Chormaic, S. (2015). Optical nanofiber-based sensors for biological and chemical detection. Sensors, 15(8), 19504–19521.

[20] Li, J., Liu, X., Xi, J., Deng, L., Yang, Y., Li, X., & Sun, H. (2023). Recent development of polymer nanofibers in the field of optical sensing. Polymers, 15(17), 3616.

[21] Chen, X., Cao, H., He, Y., Zhou, Q., Li, Z., Wang, W.,Hou, C. (2022). Advanced functional nanofibers: strategies to improve performance and expand functions. Frontiers of Optoelectronics, 15, 50.

[22] Warken, F.,Rauschenbeutel, A., & Vetsch, E. (2007). Optical nanofibers for atom trapping. Optics Express, 15(19), 11952–11958.

[23] Spillane, S. M., Pati, G. S., Salit, K., Hall, M. T., Kumar, P., Beausoleil, R. G., & Knight, J. C. (2003). Ultralow-threshold Raman laser using a spherical dielectric microcavity. Nature, 415, 621–623.

[24] Frawley, M. C., Petcu-Colan, A., Truong, V. G., & Nic Chormaic, S. (2012). Higher order mode propagation in optical nanofibers for atom trapping. Optics Communications, 285(23), 4648–4654.

[25] Nayak, K. P., Melentiev, P. N., Morinaga, M., Kien, F. L., Balykin, V. I., & Hakuta, K. (2007). Optical nanofiber as an efficient tool for manipulating and probing atomic fluorescence. Optics Express, 15(9), 5431–5438.
[26] Yalla, R., Le Kien, F., Morinaga, M., & Hakuta, K. (2012). Efficient channeling of fluorescence photons from single quantum dots into guided modes of optical nanofibers. Physical Review Letters, 109(6), 063602.
[27] Stiebeiner, A., Garcia-Fernandez, R., & Rauschenbeutel, A. (2009). Design and optimization of nanofiber-based optical traps for neutral atoms. Optics Express, 17(24), 21704–21723.
[28] Nayak, K. P., & Hakuta, K. (2014). Cavity QED with optical nanofibers. New Journal of Physics, 16(1), 013006.
[29] Ward, J. M., & Nic Chormaic, S. (2014). Optical micro- and nanofiber resonators for sensing applications. Sensors, 14(2), 3456–3480.
[30] Frawley, M. C., Truong, V. G., & Nic Chormaic, S. (2014). Optical nanofiber-based cavity QED. Journal of Physics B: Atomic, Molecular and Optical Physics, 47(22), 224014.
[31] Yalla, R., Sadgrove, M., Nayak, K. P., & Hakuta, K. (2014). Cavity quantum electrodynamics on a nanofiber using a composite photonic crystal cavity. Physical Review Letters, 113(14), 143601.
[32] Russell, L., Frawley, M. C., Truong, V. G., & Nic Chormaic, S. (2012). Optimized optical nanofiber-based atom traps for quantum optics. Journal of Physics B, 45(21), 215005