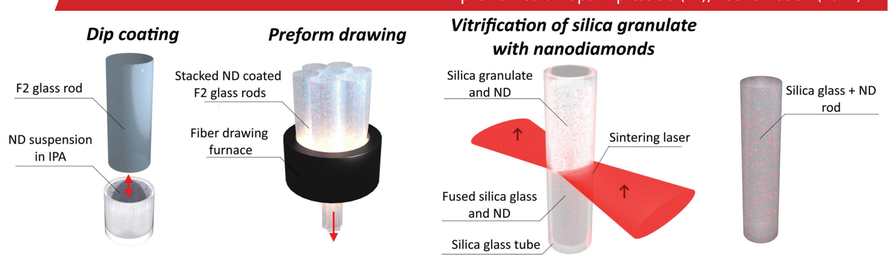
FACULTY OF PHYSICS
UNIVERSITY OF WARSAW

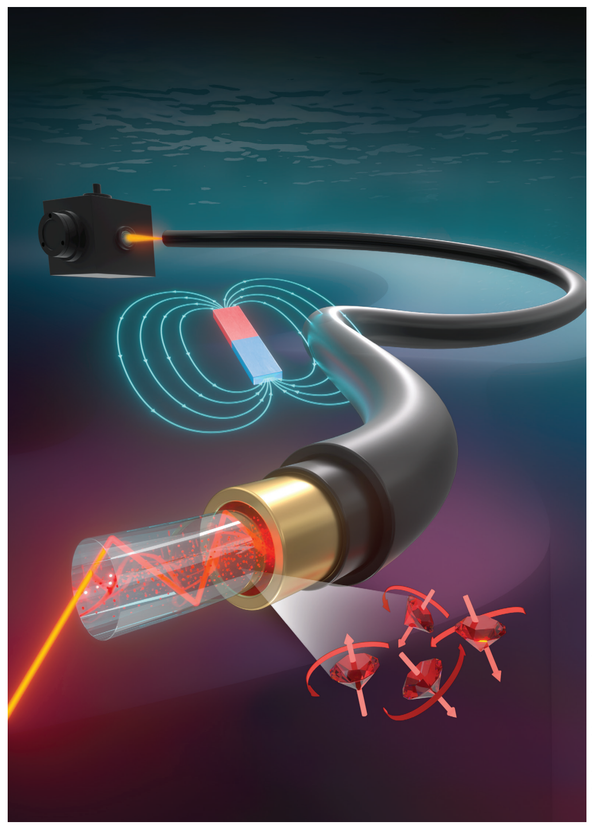
See the Fields

Optical fibers for sending of quantum information and measuring magnetic fields over large distances

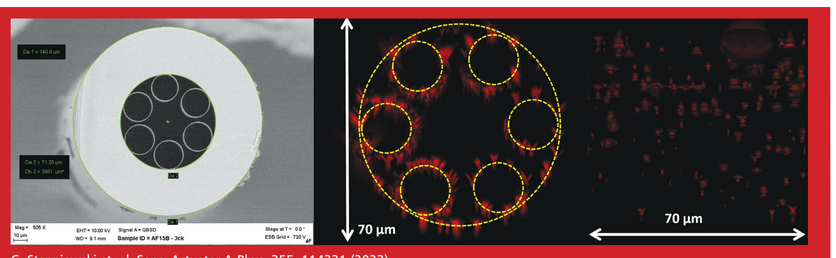
Integration of fluorescent nanodiamonds with optical fibers is a broad group of powerful techniques for scaling of magnetic field sensing. We demonstrated a new approach for combining nanodiamonds and fibers using nanostructuring to finely control nanodiamond distribution along the entire length of optical fibers. This unlocks remote optical read-out of quantum information on the electron spin in fluorescent diamond at any location along the fiber and measurement of magnetic fields in a 3D space around the fiber. Such sensors could find application in spintronics computing with magnetic switching or security systems protecting against unauthorized submerged vessels.

A. Filipkowski et. al. Opt. Express 30 (11), 19573-19581 (2022)





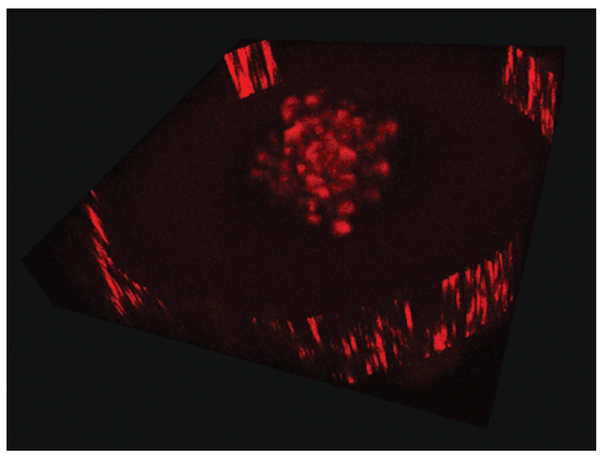
A. Filipkowski et al. Carbon 196, 10-19 (2022)



G. Stępniewski et. al. Sens. Actuator A-Phys. 355, 114321 (2023)

Distributed and microfluidics-friendly opto-magnetometry in hollow core fibers

We demonstrated practical, single-meter-scale magnetically sensitive silica glass hollow core fibers with fluorescent nanodiamonds deposited inside the entire length of the air core. These structures enabled nano-Tesla range magnetic field sensitivity where the diamond's nitrogen-vacancy center quantum fluorescence is collected and guided along the hollow core of the fiber. The nanodiamond particles are deposited in the hollow core at room temperature from a suspension; thus, their concentration can be easily controlled thanks to 100% survivability, compared to high-temperature glass-diamond integration methods. What is more, their surface can still be modified, creating interesting future possibilities for microfluidic biosensors.



G. Stępniewski, et. al. Carbon 215, 118465 (2023)

New nanoparticle-glass hybrid fibers for novel nonlinear optics

We are working on high-temperature integration of nanodiamonds with glasses drawable into standard optical fibers. The two-dimensional bonding of atoms in the nanoparticle is what can enable optical nonlinearity engineering in fibers. This modality can be achieved independently of the fiber's linear optical properties by adding just trace amounts of nanoparticles into the fiber core. The results will unlock presently inaccessible operation modes of femtosecond lasers for multicolor pulses at GHz repetition from very compact devices, bringing a new quality into ultrafast, real-time tissue imaging and frequency measurements.

Mariusz Klimczak is an associate professor at the Faculty of Physics, University of Warsaw (Ryszard Buczyński's Structured Optics and Optofluidics Group). His research interests include nonlinear optics, ultrafast science, and magneto-optics. He has held research positions at the Institute of High Pressure Physics, Polish Academy of Sciences, Institute of Electronic Materials Technology in Warsaw, and at the Université de Franche-Comté in France. He closely collaborates with Adam Wojciechowski's Magneto-optics Group at Jagiellonian University in Kraków. **Very often dreams of engaging a starship's warp drive.**

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