Nikolai N Klimov, J Laser Opt Photonics 2018, Volume 5
DOI: 10.4172/2469-410X-C5-034

International Conference on
PHOTONICS, OPTOELECTRONICS AND DISPLAY DEVICES
&
International Conference on VEHICLE FIBER-OPTICS AND PHOTONICS
September 19-20, 2018 | Philadelphia, USA

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Nanophotonics thermodynamic metrology of tomorrow

Current standards and sensors for temperature, pressure, vacuum and humidity rely mostly on century-old resistance-based metrology infrastructure, which almost reached its limits in measurement science. To drastically improve thermodynamic metrology, we propose a novel approach based on recently emerging but rapidly growing photonic technology that can provide cost-effective measurement solutions by leveraging advances in frequency metrology. In addition, this approach will align thermodynamic metrology to the emergent NIST "Quantum SI" paradigm, in which a measurement has intrinsic traceability and the line between standard is blurred. In my talk, I will give two examples related to the development of "Quantum SI" standards. First, I will show the results of our efforts in developing on-chip integrated silicon photonic thermometers with nanoscale footprint and ultra-high resolution that are capable to achieve measurement capabilities that are on-par or even better than the state-of-the-art resistance thermometry. In the second part of my talk, I will outline our endeavors to make Quantum-SI compatible sensors based on cold-atom technology. This effort focuses on miniaturizing, as much as physically possible, the laser cooling and trapping necessary for the creation of cold atom clouds. The resulting clouds, with temperatures < 1 mK, could be used to make a host of sensors, including clocks, inertial sensors and vacuum gauges in addition to being a possible component in emerging quantum technologies. Our present work within this program focuses on making a deployable vacuum gauge, that is primary and can measure vacuum pressures in the ultra-high vacuum to extreme high-vacuum regimes.

Biography

Nikolai N Klimov has received his PhD in Experimental Condensed Matter Physics from Rutgers University and a postdoctoral study from the Center for Nanoscale Science and Technology & Physical Measurement Laboratory at NIST. He is currently a research physicist and a project leader at the Physical Measurement Laboratory at NIST. He has published more than 25+ papers in peer-reviewed journals and 30+ presentations on international conferences. He is currently one of the organizing committee members of AVS 65th International Symposium and 62nd Internation Conference on Electron, Ion and Photon Beam Technology for this year.

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