INVITED SPEAKERS

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Pneumatic Photonic Crystals: Properties and Application in Sensing and Metrology

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Abstract: A pneumatic photonic crystal i.e. a medium containing regularly distributed gas-filled voids divided by elastic walls is proposed as an optical indicator of pressure and temperature. The indicator includes layered elastic platform, optical fibers and switching valves, all enclosed into a chamber. We have investigated theoretically distribution of deformation and pressure inside a pneumatic photonic crystal, its bandgap structure and light reflection changes depending on external pressure and temperature. At chosen parameters and fixed temperature the multi-scale device may cover the pressure interval (0, 10) bar with nanobar accuracy. The optical devices considered offer an opportunity to organize precise simultaneous monitoring of pressure and temperature in quick processes in gas or liquid flow. Various applications of opto-pneumatic media in sensing and signal processing are reviewed. A method is proposed to determine the fundamental molar gas constant R with the relative standard uncertainty near 10^{-10} that is based on extra accurate volume controlling and high sensitive pressure measurements in the framework of scale echeloning procedure. An essential moment of the method is uniting of results for two measurement scales with increased relative standard uncertainty (10^{-5}) to obtain the higher precise level. A calibrated stable area of fixed temperature is used in vicinity of the triple point of water.

Keywords: Photonic Crystal; Optophotonic Media; Optical Sensors; All-optical Signal Processing.