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Finite element analysis and optimization of cylindrical resonant photoacoustic cell

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Photo acoustic phenomenon is useful to develop technologies for spectroscopic, microscopic and imagining applications. Of late, it has gained wider significance in biomedical engineering. Photo acoustic spectroscopy has been recognised as an effective and inexpensive method for measurement of concentration of gaseous compounds. Sensitivity of resonant photo acoustic cell, which is defined as its ability to generate high amplitude of acoustic pressure at the location of microphone, for a given amount of absorbed radiation, is a key design objective of the cell. Various factors effect sensitivity of the photoacoustic cell and its geometry is the most deciding one. In this work, photoacoustic response of cylindrical resonant cells is simulated by solving Navier-Stokes equation, continuity equation, energy equation and the equation of state, using FEM analysis. Numerical results are validated with experimental results reported in the literature. To find the optimum dimensions of the resonant cell and the buffer cell, Taguchi method of design of experiments is applied. Numerical model with optimized dimensions is found to have better sensitivity.

Biography

Madhusoodanan Mannoor has received his BTech in Mechanical Engineering from Kerala University, Thiruvanathapuram, India in 2004. He completed his MTech in Energy Management from National Institute of Technology (NIT), Calicut, India in 2007. Then he worked for 4 years as Field Engineer in Nuclear Power Corporation of India Limited at Kudankulam Nuclear Power Plant, India and subsequently as Assistant Professor in the Department of Mechanical Engineering, at Government Engineering College, Kannur, India. Presently, he is pursuing Doctoral studies in the Department of Mechanical Engineering at Dong-A University, Busan, Republic of Korea. His research interests are in the field of photo acoustics, computational fluid dynamics, molecular dynamics and dielectrics.

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