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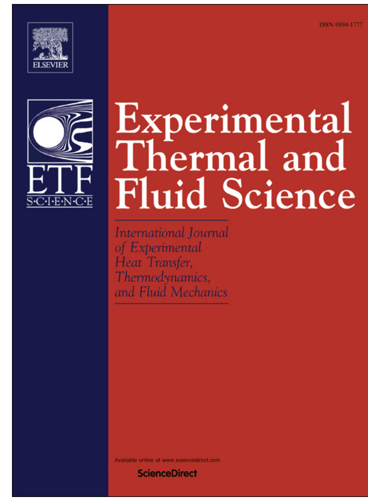

Molecular tagging velocimetry by direct phosphorescence in gas microflows: correction of Taylor dispersion

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Abstract: *Molecular tagging velocimetry is a little-intrusive technique based on the properties of specific molecules able to emit luminescence once properly excited. Several variants of this technique have been successfully developed for analyzing external gas flows or internal gas flows in large systems. There is, however, very few experimental data on molecular tagging velocimetry for gas flows in mini or microsystems, and these data are strongly affected by the molecular diffusion of the tracer molecules. In the present paper, it is demonstrated that the velocity field in gas microflows cannot be directly deduced from the measured displacement field without taking into account Taylor dispersion effects. For that purpose, the benchmark case of a Poiseuille gas flow through a rectangular channel 960 µm in depth is experimentally investigated by micro molecular tagging velocimetry using acetone vapor as a molecular tracer. An appropriate reconstruction method based on the advection diffusion equation is used to process the data and to correctly extract the velocity profiles. The comparison of measured velocities with flowrate data and with theoretical velocity profiles shows a good agreement, whereas when the reconstruction method is not implemented, the extracted velocity field exhibits qualitative and quantitative anomalies, such as a non-physical slip at the walls. The robustness of the reconstruction method is demonstrated on flows with light and heavy molecular species, namely helium and argon, at atmospheric as well as at*