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# Thickness and volume measurements of a Richtmyer–Meshkov instability-induced mixing

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A simultaneous three-directional laser absorption technique for the study of a shock-induced Richtmyer–Meshkov instability mixing zone is reported. It is an improvement of a CO2 laser absorption technique, using three detectors during the same run, through three different directions of the test section, for the simultaneous thickness measurement of the mixing zone near the corner, near the wall and at the centre of a square-cross-section shock tube. The three-dimensional mean front and rear shapes of the mixing zone, its thickness and volume are deduced from the experimental measurements. The cases when the shock wave passes from a heavy gas to a light one, from one gas to another of similar densities and from a light gas to a heavy one, are investigated before and after the mixing zone compression by the reflected shock, for different incident shock wave Mach numbers. It is shown that the mixing zone is strongly deformed by the wall boundary layer when it becomes turbulent. Consequently, the thickness of the mixing zone is not constant along the shock tube cross-section, and the measurement of the mean volume of the mixing zone appears to be more appropriate than its mean thickness at the centre of the shock tube. The influence of the incident shock wave Mach number is also studied. When the Atwood number tends to zero, we observe a limit-like regime and the thickness, or the volume, of the mixing zone no longer varies with the incident shock wave Mach number. Furthermore, a series of experiments undertaken with an Atwood number close to zero enabled us to define a membrane-induced minimum mixing thickness, L0, depending on the initial configuration of the experiments. From the experimental data, a hypothesis about the mixing zone thickness evolution law with time is deduced on the basis of L0. The results are found to follow two very different laws depending on whether they are considered before or after the establishment of the plenary turbulent regime. Fractal and multifractal measurements of schliering visualizations allow to distinguish mixing areas.