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Experiments on a Miniature Hypervelocity Shock Tube DOUGLAS TASKER, CARL JOHNSON, MICHAEL MURPHY, MARK LIEBER, Los Alamos National Laboratory, MIMS TEAM — A miniature explosively-driven shock tube, based on the Voitenko compressor design [1], has been designed to produce shock speeds in light gases in excess of 80 km/s. Voitenko compressors over 1 meter in diameter have been reported but here experiments on miniature shock tubes with ∼1-mm bore diameters are described. In this design a 12-mm diameter explosive pellet drives a metal plate into a hemispherical gas compression chamber. Downstream from the piston a mica diaphragm separates the gas from an evacuated shock tube which is confined by a massive polymethylmethacrylate (PMMA) block. The diaphragm eventually ruptures under the applied pressure loading and the compressed gases escape into the evacuated shock tube at hyper velocities. The progress of gas shocks in the tube and bow shocks in the PMMA are monitored with an ultra-high-speed imaging system, the Shock Wave Image Framing Technique (SWIFT) [2]. The resulting time-resolved images yield two-dimensional visualizations of shock geometry and progression. By measuring both the gas and bow shocks, accurate and unequivocal measurements of shock position history are obtained. The experimental results were compared with those of hydrocode modeling to optimize the design. The first experiments were suboptimum in that the velocities were ∼16 km/s. Progress with these experiments will be reported.

[1] A. E. Voitenko, Dokl. Akad. Nauk SSSR 158 (6), 1278-1280 (1964).
[2] M. J. Murphy and S. A. Clarke, in Dynamic Behavior of Materials, Volume 1, (2013), pp. 425-432.

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