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Investigations of spontaneous ignition of high-pressure hydrogen release based on detailed chemical kinetics HIROSHI TERASHIMA, MITSUO KOSHI, TOSHIO MOGI, RITSU DOBASHI, The University of Tokyo — A numerical simulation of spontaneous ignition of high-pressure release in a length of duct is performed to explore ignition mechanisms. The present study adopts a rectangular duct and focuses on effects of initial diaphragm shape on spontaneous ignitions. The Navier-Stokes equations with a detailed chemical kinetics mechanism are solved in a manner of direct numerical simulation. A conventional numerical approach is used for solving the Navier-Stokes equations, while the chemical source term is integrated by a dynamic multi-timescale method for alleviating the stiffness. Detailed mechanisms of spontaneous ignitions are discussed for various initial diaphragm shapes. For a straight diaphragm shape, the ignition occurs only near the wall region due to the adiabatic wall condition, while, for a largely deformed diaphragm shape, the three ignition events: ignition due to leading shock wave reflection at the wall, hydrogen penetration into shock-heated air near the wall, and deep penetration of hydrogen into shock-heated air behind the leading shock wave, are identified.

Hiroshi Terashima
The University of Tokyo

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