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Mechanisms of strong pressure wave generations during knocking combustion: compressible reactive flow simulations with detailed chemical kinetics HIROSHI TERASHIMA, The University of Tokyo, MITSUO KOSHI, Yokohama National University — Knocking is a very severe pressure oscillation caused by interactions between flame propagation and end-gas autoignition in spark-assisted engines. In this study, knocking combustion modeled in one-dimensional space is simulated using a highly efficient compressible flow solver with detailed chemical kinetics for clarifying the process of knocking occurrence. Especially, mechanisms of strong pressure wave generation are addressed. A robust and fast explicit integration method is used to efficiently handle stiff chemistry, and species bundling for effectively estimating the diffusion coefficients. The detailed mechanisms such as n-butane of 113 species and n-heptane of 373 species are directly applied. Results demonstrate that the negative temperature coefficient (NTC) region of n-heptane significantly influence the knocking timing and intensity. In the NTC region, stronger pressure wave is generated due to rapid heat release of a very small portion in the end-gas, which is attributed to low temperature oxidation and inhomogeneous temperature distributions in the end-gas. The knocking intensity is thus amplified in the NTC region, taking a maximum value. In the case of n-butane with no NTC region, relatively weak knocking intensity is observed in all conditions with no clear peak.

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