Comparative Shock-Tube Study of Autoignition and Plasma-Assisted Ignition of C$_2$-Hydrocarbons Ilya Kosarev, Svetlana Kindysheva, Eugeny Plastinin, Nikolay Aleksandrov, Moscow Institute of Physics and Technology, Andrey Starikovskiy, Princeton University —

The dynamics of pulsed picosecond and nanosecond discharge development in liquid water, ethanol and hexane Using a shock tube with a discharge cell, ignition delay time was measured in a lean ($\phi = 0.5$) C$_2$H$_6$:O$_2$:Ar mixture and in lean ($\phi = 0.5$) and stoichiometric C$_2$H$_4$:O$_2$:Ar mixtures with a high-voltage nanosecond discharge and without it. The measured results were compared with the measurements made previously with the same setup for C$_2$H$_6$-, C$_2$H$_5$OH- and C$_2$H$_2$-containing mixtures. It was shown that the effect of plasma on ignition is almost the same for C$_2$H$_6$, C$_2$H$_4$ and C$_2$H$_5$OH. The reduction in time is smaller for C$_2$H$_2$, the fuel that is well ignited even without the discharge. Autoignition delay time was independent of the stoichiometric ratio for C$_2$H$_6$ and C$_2$H$_4$, whereas this time in stoichiometric C$_2$H$_2$- and C$_2$H$_5$OH-containing mixtures was noticeably shorter than that in the lean mixtures. Ignition after the discharge was not affected by a change in the stoichiometric ratio for C$_2$H$_2$ and C$_2$H$_4$, whereas the plasma-assisted ignition delay time for C$_2$H$_6$ and C$_2$H$_5$OH decreased as the equivalence ratio changed from 1 to 0.5. Ignition delay time was calculated in C$_2$-hydrocarbon-containing mixtures under study by simulating separately discharge and ignition processes. Good agreement was obtained between new measurements and calculated ignition delay times.