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Low Energy Electron Scattering from Fuels[1]

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We report an investigation of processes that occur during the ignition of the plasma and its consequences in post-discharge time for an internal combustion engine, in order to find the appropriate parameters to be used in cars that operate with lean mixtures air-fuel. The relevance of this theme has attracted much attention, and has been one of the subjects of collaboration between experimental and theoretical groups in the USA and Brazil. We have produced some basic information necessary to modeling spark ignition in alcohol- fuelled engines. Total cross sections of electron scattering by methanol and ethanol molecules were obtained, using the linear transmission method based on the Beer-Lambert law to first approximation. Measurements and calculations of differential cross sections for low-energy (rotationally unresolved) electron scattering were also obtained, for scattering angles of 5°–130°. The measurements were taken using the relative flow method with an aperture source, and calculations using two different implementations of the Schwinger multichannel method, one that takes all electrons into account and is adapted for parallel computers, and another that uses pseudopotentials and considers only the valence electrons. Additionally to these, computer simulation studies of electronic discharge in mixtures of ethanol were performed, using a Zero-Dimensional Plasma Kinetic solver. Previous reported models for combustion of ethanol and cross sections data for momentum transfer of electron collisions with ethanol were used. The time evolutions of the main species densities are reported and the ignition time delay discussed.

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