Ignition Processes - Fast Dynamics Driven by Chemical Reaction

Jürgen Warnatz

Universität Heidelberg, IWR, D-69120 Heidelberg, Germany

The time-dependent process of starting with reactants and evolving in time towards a steadily burning flame is called ignition and is always time-dependent and includes chemical processes completely different from that in fully developed combustion. Examples of ignition processes include induced ignition (such as occurs in gasoline engines induced by a spark), autoignition (such as occurs in Diesel engines), and more special cases like photo-ignition or catalytic ignition (caused by photolytic or catalytic generation of radicals). The treatment of ignition demands additional terms in the conservation equations, accounting for the temperature increase (or decrease) caused by compression (or expansion) of the mixture considered. The characteristic time at which pressure equilibrates is the characteristic dimension of the system divided by the sound speed. If the characteristic time of the ignition process is smaller than the pressure equilibration time, the pressure equilibration is too slow to allow the assumption of a spatially uniform pressure, and shock waves can be induced, potentially leading to a lot of dynamics of the system under consideration. The chemical processes occurring during auto-ignition in the gas phase (in special at lower temperatures) and during induced ignition in the gas phase are discussed. In any case, mechanisms are resulting which are much too large for processing in a 3D application. Thus, possibilities are discussed to generate reduced reaction mechanisms for ignition.

Correspondence to : juergen@warnatz.de