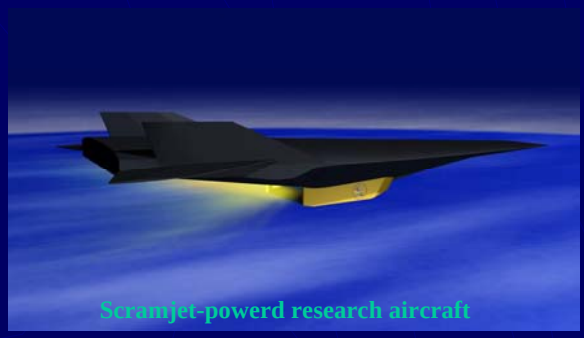
Why studying the thermal stability of scramjet fuel?

• at Mach 6, the air enters the engine at the temperature of 1650K.
• at Mach 12, it enters at 4800K.

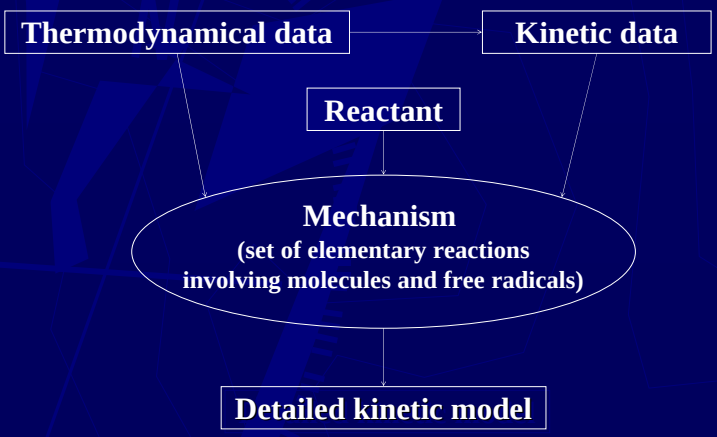
The endothermic capabilities of the thermal decomposition of the fuel circulating on the composite material walls of the engine may be used.


Scramjet-powerd research aircraft

This technique requires accurate predictive models of the thermal decomposition of the fuel in order to :
• quantify the heat transfer
• know the composition of the mixture entering the reaction chamber

Modeling of the thermal decomposition of the fuel.

Kinetic Model Design



Mechanism

Primary mechanism :

•Unimolecular initiation by bond fission ($C_{12}H_{26} \Rightarrow {}^{\bullet}CH_3 + {}^{\bullet}C_{11}H_{23}$)

•Propagation by β-scission decomposition (${}^{\bullet}C_3H_7 \Rightarrow {}^{\bullet}CH_3 + C_2H_4$)

•Propagation by isomerization involving cyclic transition state

•Propagation by metathesis (${}^{\bullet}H + C_{12}H_{26} \Rightarrow H_2 + {}^{\bullet}C_{12}H_{25}$)

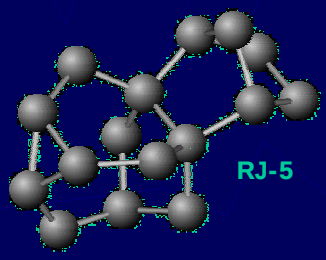
•Termination steps (combination of two free radicals)

Secondary mechanism :

•Secondary reactions of alkanes, alkenes and dienes formed in the primary mechanism (metathesis, β-scission, unimolecular initiations, additions, abstractions of hydrogen atoms…)

What fuels are being studied ?

•An investigation modeling of the thermal decomposition of the n-dodecane ($C_{12}H_{26}$), a component of some jet fuels, has already be done at the DCPR.
•An experimental study and the modeling of the thermal decomposition of a polycyclic hydrocarbon (e.g. RJ-4, RJ-5…) in a jet stirred reactor is currently conducted.


RJ-5