Supercritical Fuel Pyrolysis

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SUPERCritical CONDITIONS FOR FUEls IN THE NEXT GENERATION OF HIGH-SPEED AIRCRAFT

Fuel is used as a cooling agent in high-speed aircraft.

High pressures and high temperatures are sustained in the fuel lines.

Pyrolytic reactions produce poly-cyclic aromatic hydrocarbons (PAH), precursors to carbonaceous fuel-line deposits.

To understand the reaction chemistry, supercritical pyrolysis experiments are performed with model fuels.
1-methylnaphthalene

$T_c = 499^\circ C$
$P_c = 36$ atm

$n$-decane

$T_c = 345^\circ C$
$P_c = 21$ atm
Supercritical Fuel Pyrolysis Reactor System
Summary and Conclusions

Supercritical 1-methylnaphthalene pyrolysis
- quantified fuel conversion and product yields, as functions of temperature, from 550 to 600 °C, at 80 atm and 140 s;
- PAH yields increase dramatically with temperature at the highest temperatures, especially for the largest PAH;
- differences in product yields related to mechanisms of formation.

Supercritical \( n \)-decane pyrolysis
- applied normal-phase HPLC fractionation / reversed-phase HPLC analysis;
  - demonstrates a 6- to 7-fold increase in the number of identifiable products;
  - greatly improves component resolution and quantifiability;
  - permits the identification of large PAH structures that may be key precursors to carbonaceous solids;
- identified 276 product PAH ranging in size up to 9 fused aromatic rings;
- quantified PAH product yields, as functions of temperature, from 530 to 570 °C, at 100 atm and 140 s;
- at 100 atm, PAH yields increase dramatically with temperature, especially as temperatures approach the onset of carbonaceous solids formation.
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