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Pyrolysis of Fuels in a Micro-Reactor: Radical/Radical Reactions Make PAHs

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To understand the thermal decomposition mechanisms of fuels, we are developing a tiny flow tube to study the thermal cracking of complex organic molecules. We use a heated 1 mm × 2 cm SiC microtubular reactor to decompose complex fuels. Thermal decomposition of 0.1 % samples mixed with He or Ar carrier gases takes place at pressures of 75 —250 Torr and at temperatures up to 1700 K. Residence time of the organics in the reactor is roughly 25 —150 µsec. The pyrolysis products are identified by several independent techniques: VUV photoionization mass spectroscopy, resonance enhanced multiphoton ionization, microwave spectroscopy, and matrix-isolated, infrared absorption spectroscopy.

Aromatics (toluene, xylenes, alkylbenzenes, etc.) make up roughly ¼ of all aviation fuels. Thermal cracking of these fuels produces a pool of "persistent"radicals. We have observed radical/radical reactions to produce benzene and naphthalene. These are early steps in the formation of "soot".

CH_3 + C_5H_5 ⟶ C_6H_6 (benzene) + 2 H atoms
C_5H_5 + C_5H_5 ⟶ $C_{10}H_8$ (naphthalene) + 2 H atoms

Summary

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