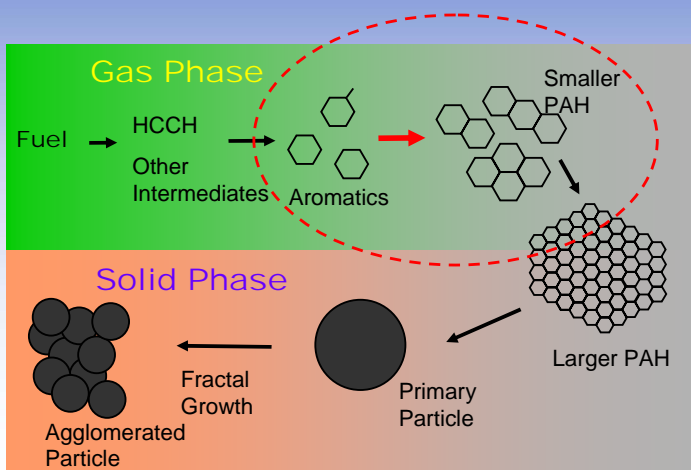


# PAHs Formation from Benzene in a Laminar Flow Reactor

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- A Particles growing process is considered as shown in Fig. 1.
- To understand an overall soot formation behavior, each processes should be revealed.
- The most unknown period is a Growth of PAHs from single aromatic ring.
- Fundamental knowledge of this period must be essential.



Fig. 2 A picture of flow reactor used in this study.

## Objective

**Obtaining the tendency of PAH formation from single aromatic ring species using a laminar flow reactor.**

**Benzene was selected for a fuel. Species with two or three aromatic ring were measured with GC-MS. The effect of environmental temperature and equivalence ratio are discussed.**

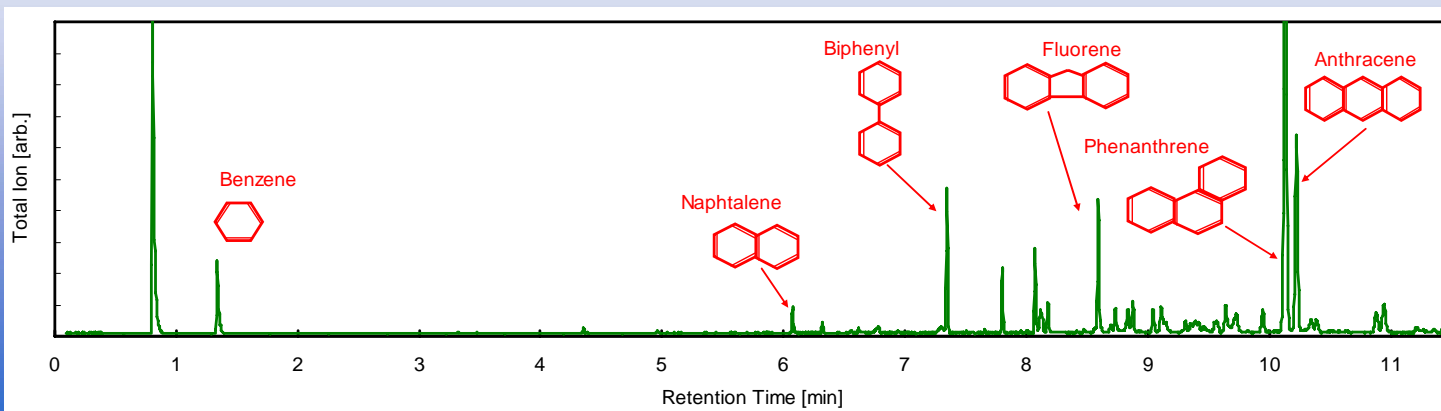


Fig. 3 Raw data acquired by GC-MS. Temperature = 1253K, without oxygen.

## Experimental Set-up

The dimensions of flow reactor used are;  $\Phi=50\text{mm}$ ,  $t=5\text{mm}$  and effective length= $300\text{mm}$ .

Total flow was set to 4SLM, fuel flow= $30\text{sccm}$  and buffer gas was adopted  $\text{N}_2$  in all experiments.

Benzene, naphthalene, biphenyl, fluorene, phenanthrene, anthracene acetylene and ethylene were detected.

## Without Oxygen

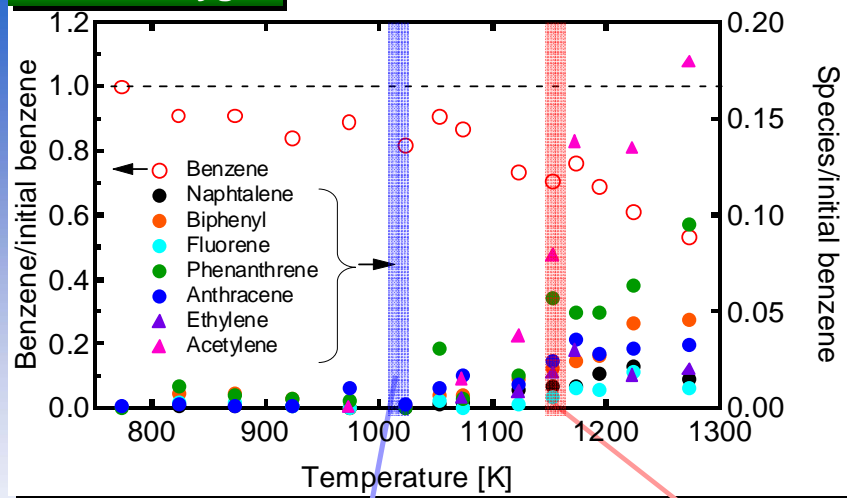


Fig. 4 Species formation relative to initial benzene as a function of temperature without oxygen.

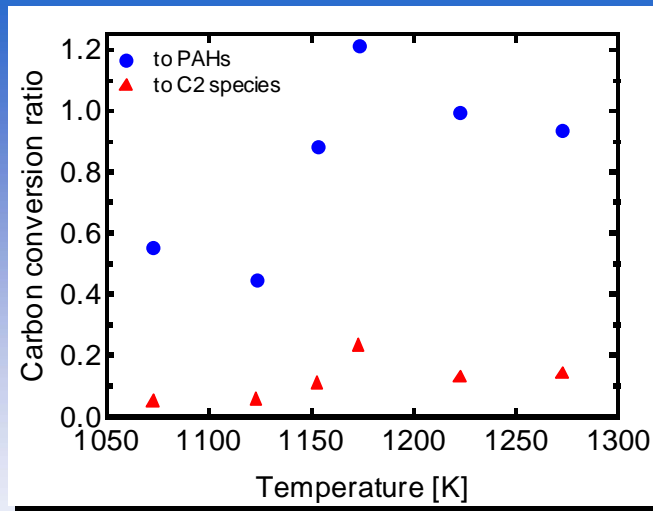


Fig. 5 Conversion ratio of Carbon atom included in benzene as a function of temperature.

- Benzene began to convert over 1050K.
- At 1273K, about 50% of benzene were converted to smaller or larger molecules.
- Major species were Acetylene, Phenanthrene and Biphenyl.
- At any temperature, a conversion to PAHs was favor than a decomposition (about 10 times larger).

## Addition of O<sub>2</sub>

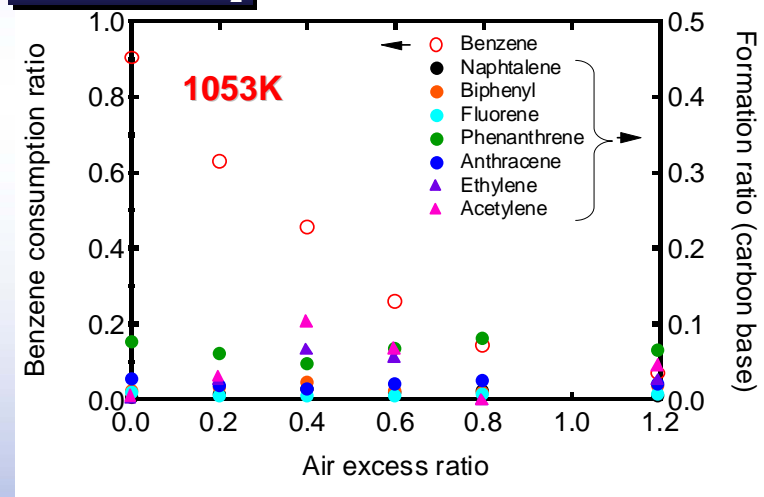


Fig. 6 Carbon number based species relative to initial fuel as a function of air excess ratio at 1053K.

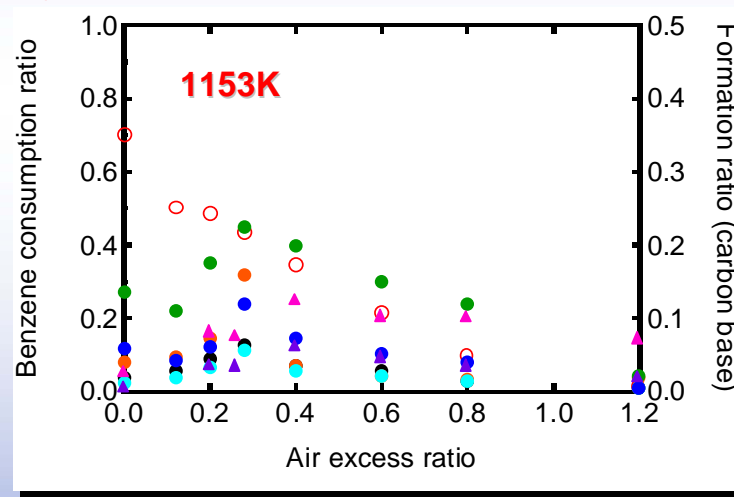


Fig. 7 Carbon number based species relative to initial fuel as a function of air excess ratio at 1153K.

- Benzene was disappeared linearly as increasing air excess ratio.
- Almost all of fuel was consumed at air excess ratio = 1.
- At 1053K (slightly lower temperature at which benzene began to convert in case without oxygen), increases of PAH were not observed.
- At 1153K (slightly higher), peaks of PAH formations were observed in air excess ratio = 0.3.

## Conclusions

**PAH growth from benzene was observed using laminar flow reactor. PAH grew in case that temperature was over 1050K. In this temperature range, PAH growth was more dominant than decomposition to C<sub>2</sub> species. The most activated range of the growth is near air excess ratio = 0.3.**

## Acknowledgement

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