Outline

<table>
<thead>
<tr>
<th>Date</th>
<th>Class</th>
<th>Comb. Lecture</th>
<th>Problem Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 11</td>
<td>19</td>
<td>Concepts, Flames, Premixed, Diffusion</td>
<td>1</td>
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<tr>
<td>13</td>
<td>20</td>
<td>Heats of Formation, Heats of Reaction, Heat Capacities, Entropies</td>
<td>2 #1</td>
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<tr>
<td>18</td>
<td>21</td>
<td>Stoichiometry, Equilibrium Constants, NASA-Lewis Code</td>
<td>3 #2, #3</td>
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<tr>
<td>20</td>
<td>22</td>
<td>Adiabatic Flame Temperature, Multi-Component Equilibrium, NASA-Lewis Code</td>
<td>4 #4</td>
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<tr>
<td>27</td>
<td>28</td>
<td>BYU Friday, NO Class, Thanksgiving</td>
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<tr>
<td>Dec 2</td>
<td>2</td>
<td>Heterogeneous Combustion</td>
<td>5 #5</td>
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<td>4</td>
<td>26</td>
<td>NOx, Mechanical, NOx</td>
<td>6 #6</td>
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<td>9</td>
<td>27</td>
<td>Turbulence, Explosions, Flames</td>
<td>7 #7</td>
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<tr>
<td>11</td>
<td>28</td>
<td>Review, Turbulence, Explosions</td>
<td>8 #8</td>
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Progress

- Diffusion Flames
- Premixed Flames
- Homogeneous Combustion
- Heterogeneous Combustion
- Deflagration
- Detonation
- Stoichiometric
- Equivalence Ratio
- Extinction
- Flammability Limits
- Heat of Vaporization
- Heat of Combustion
- High Heating Value
- Chemical Equilibrium
- Dissociation
- Heats of formation & reaction
- Underventilated flames
- Overventilated flames
- Adiabatic Flame Temperature
- Soot
- Blackbody Radiation
- Thermal NOx
- Turbulence
- Ignition
- Flame Speed
- Flashback

Outline (cont.)

- How does a candle work?
- How does a fireplace work?
  - Regimes of heterogeneous combustion
  - Sources of NOx
  - Single particle vs. cloud combustion
- Heterogeneous Combustion
- As rec'd, dry, and daf bases for coal
- Turbulence effects
- Swirl
- Use of NASA-Lewis code
- Elementary step reaction sequences vs. global mechanisms

Examples of Heterogeneous Combustion

1. 1989 Stadium of Fire
2. Coal Particle
3. Forest Fire

1989 Stadium of Fire

BYU Football Stadium

Alan Osmond’s Goal:
1 million firecrackers to go off in series in 7 seconds
Oops!

- Group combustion (not single firecracker!)
- No one was injured (thankfully!)
- People nearby got their eyebrows singed!

Coal Particle Video

Ken Bateman
MS in Mech Eng, BYU

Forest Fire Video

Jack Cohen,
USDA Forest Fire Research Station
Missoula, MT
Kitchen Fire

- This dramatic video (30-seconds, very short) shows how to deal with a common kitchen fire - oil in a frying pan. Please read the following introduction and then watch the show... It's a real eye-opener!! Perhaps you'll want to send this one on to your family and friends.

- A certain individual wrote that, when stationed in Charleston Navy base at the Fire Fighting Training school, they would demonstrate this same scenario with a deep fat fryer set on the fire field. An instructor would don a fire suit and using an 8 oz Cup at the end of a 10 foot pole toss water onto the grease fire.

- The results got the attention of the students. The water, being heavier than the oil, sinks to the bottom where it instantly becomes superheated. The EXPLOSIVE force of the steam blows the burning oil up and out. On the open field, it became a thirty foot high fireball that resembled a Nuclear Blast. Inside the confines of a kitchen, the fire ball hits the Ceiling and fills the entire room. Also, do not throw sugar or flour on a grease fire. One cup creates an explosive force.