Bakeout

Some Considerations

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Bakeout

Production of Ultrahigh Vacuum

Fig. 10.1 Pressure vs time with $V = 1$ litre, $S = 1$ litre sec$^{-1}$, $A = 100$ cm$^2$ covered with a monolayer at $t = 0$.
(a) $T = 295^\circ$K
(b) $T = 573^\circ$K

(Hobson 1961a).
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Table 2: Outgassing rates before and after 423K bake

<table>
<thead>
<tr>
<th>gas</th>
<th>before bake</th>
<th>after 700 hr bake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>torr liters/sec cm(^2)</td>
<td>torr liters/sec cm(^2)</td>
</tr>
<tr>
<td>H(_2)O</td>
<td>( J = \frac{1.2 \times 10^{-8}}{t(\text{hrs})} )</td>
<td>( J &lt; 8.6 \times 10^{-18} )</td>
</tr>
<tr>
<td>CO</td>
<td>( J &lt; \frac{5.8 \times 10^{-11}}{t(\text{hrs})} )</td>
<td>( J &lt; 5 \times 10^{-16} )</td>
</tr>
<tr>
<td>CO(_2)</td>
<td>( J &lt; \frac{4.6 \times 10^{-11}}{t(\text{hrs})} )</td>
<td>( J &lt; 1.6 \times 10^{-16} )</td>
</tr>
<tr>
<td>Hydrocarbon ( \sum 41, 43, 55, 57 )</td>
<td>( J &lt; \frac{2.2 \times 10^{-11}}{t(\text{hrs})} )</td>
<td>( J &lt; 1.2 \times 10^{-17} )</td>
</tr>
</tbody>
</table>
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FIG. 3. (a) Molecular yield vs photon beam dose for $\text{H}_2$, CO and $\text{CO}_2$. (b) Molecular yield vs photon beam dose for $\text{CH}_4$, $\text{H}_2\text{O}$ and $\text{O}_2$. 
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Photon stimulated desorption of $\text{H}_2\text{O}$, Showing an exponential variation.
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Lifetime Recovery @ I_b > 100mA
(After Dipole 9 Vessel Change)

Pressure Recovery after Shutdown

DAYS AFTER STARTUP
LIFETIME (hours)

DAYS AFTER STARTUP
SV.AVPR.01 (torr)
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![Graph showing outgassing rate vs. time for different conditions.](image)

- **Graph Details:**
  - X-axis: Time (minutes)
  - Y-axis: Outgassing rate (Torr/s/cm²)
  - Data points and lines represent different conditions:
    - 1 Baked, T=310, P₀=8.0, tᵣ=60
    - 2 Baked, T=310, P₀=0.8, tᵣ=60
    - 3 Unbaked, T=310, P₀=0.8, tᵣ=60
    - 4 Baked, T=310, P₀=0.12, tᵣ=60
    - 5 Baked, T=310, P₀=1.2x10⁻², tᵣ=60
    - 6 Baked, T=310, P₀=8.0x10⁻⁴, tᵣ=60
# Bakeout

<table>
<thead>
<tr>
<th>List of sources</th>
<th>In situ bakeout</th>
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</thead>
<tbody>
<tr>
<td>CERN, Switzerland</td>
<td>Yes. Have 2 bakeout procedures depending upon the material. Aluminium is baked at 150ºC and STST at 300ºC. They use the water cooling channels for baking Al and electrical heater tape for STST.</td>
</tr>
<tr>
<td>ELETTRA, Italy</td>
<td>No. They have tried both with and without bakeout. They conclude that they do not need an in-situ bakeout (except the septum tank because of its large internal surface area). They believe the beam to be the best cleaning agent.</td>
</tr>
<tr>
<td>ESRF, France</td>
<td>Yes and No. They usually bake the ID chambers but they have found that this causes problems, several leaks have occurred due to corrosion. When they vent they try to keep the chamber warm (80ºC).</td>
</tr>
<tr>
<td>KEKB, Japan</td>
<td>No. All components are pre-baked before installation. Afterwards PSD is deemed sufficient. The ion-pumps are baked in-situ.</td>
</tr>
<tr>
<td>NSLS, USA</td>
<td>No. All components are pre-baked prior to installation and cleaned using the Ar glow discharge. Once components are installed the beam is sufficient for cleaning.</td>
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<tr>
<td>Photon Factory, Japan</td>
<td>No. Ring is successfully conditioned without an in situ bakeout. All components are pre-baked prior to installation.</td>
</tr>
<tr>
<td>LNLS, Brazil</td>
<td>Yes. Bakeout performed after each shutdown.</td>
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</table>
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Summary

• Bakeout at modest temperatures (150-250°C) removes water, CO, CO₂ reasonably efficiently
• Exposure to modest beam doses (~$10^{22} - 10^{23}$ photon/m) removes water, CO, CO₂ reasonably efficiently
• Once a reasonable model of the vacuum system of a machine is established, some comparison of the relative efficiencies of the processes (in terms of timescales) can be made.
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References

Slide
2  J P Hobson, Trans AVS Vac Symp 8 26, 1961
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4,5 C Herbeaux & P Marin, J Vac Sci Technol A17 635 1999
6  SRS Data
7  M Li & H F Dylla, J Vac Sci Technol A12 1772 1994
8  K J Middleman, DL, survey data, 2001