[H_2] Evolution Data From Benzene Photolysis @ 173 nm VUV

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Abstract:

Hydrogen gas was successfully evolved from liquid Benzene at STP with a 173 nm VUV light source. An MQ8 gas sensor was used in conjunction with an Arduino Uno and code from Sandbox Electronics. The sensors response to volatilized Benzene was measured, and it is shown that no signal was produced by these gaseous hydrocarbons indicating that the evaporation of monomer species is not responsible for the data gathered in figures 2 or 3. However, a strange phenomenon was noted when the light source was switched on wherein the sensor data values would quickly fall to zero with some intermittent noise. The cause of this has yet to have been determined, but it is likely a result of the large magnetic field produced from the transformer for the lights power supply (≈100,000 V). For the moment, these zero values have simply been omitted from the graphs in figures 2 and 3, hence the discontinuities in the curves, however, a clear trend is still visible.

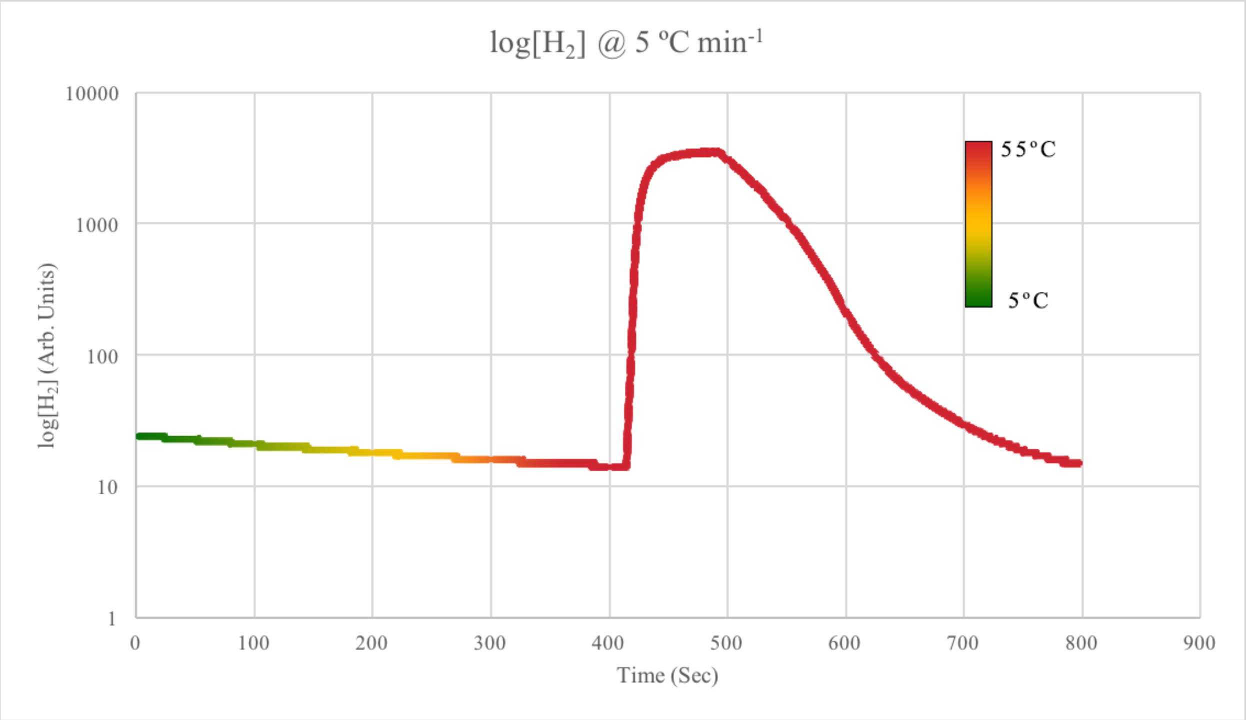

Figure 1;

The MQ8 sensors response to volatilized Benzene is illustrated in the above figure. From time $0 < t <$ ≈400 seconds, liquid Benzene was evaporated on a hot plate in a closed vessel with the sensor. No obvious trend is evident. At $t \approx 400$ seconds, H_2 gas was injected into the vessel and a sharp spike in concentration is observed. At $t \approx 500$ seconds where the slope of the tangent line is zero, the chamber was opened and allowed to vent until $t \approx 800$ seconds. Ultimately, H_2 concentration was shown to return to a base level, and further, it was shown that even in the presence of a concentrated gaseous Benzene atmosphere, the sensor was able to selectively distinguish between H_2 and other hydrocarbons. This data lends confidence to the other graphs and suggests that any observed signal from the MQ8 sensor is a result of the evolution of Hydrogen gas and not volatilized Benzene.

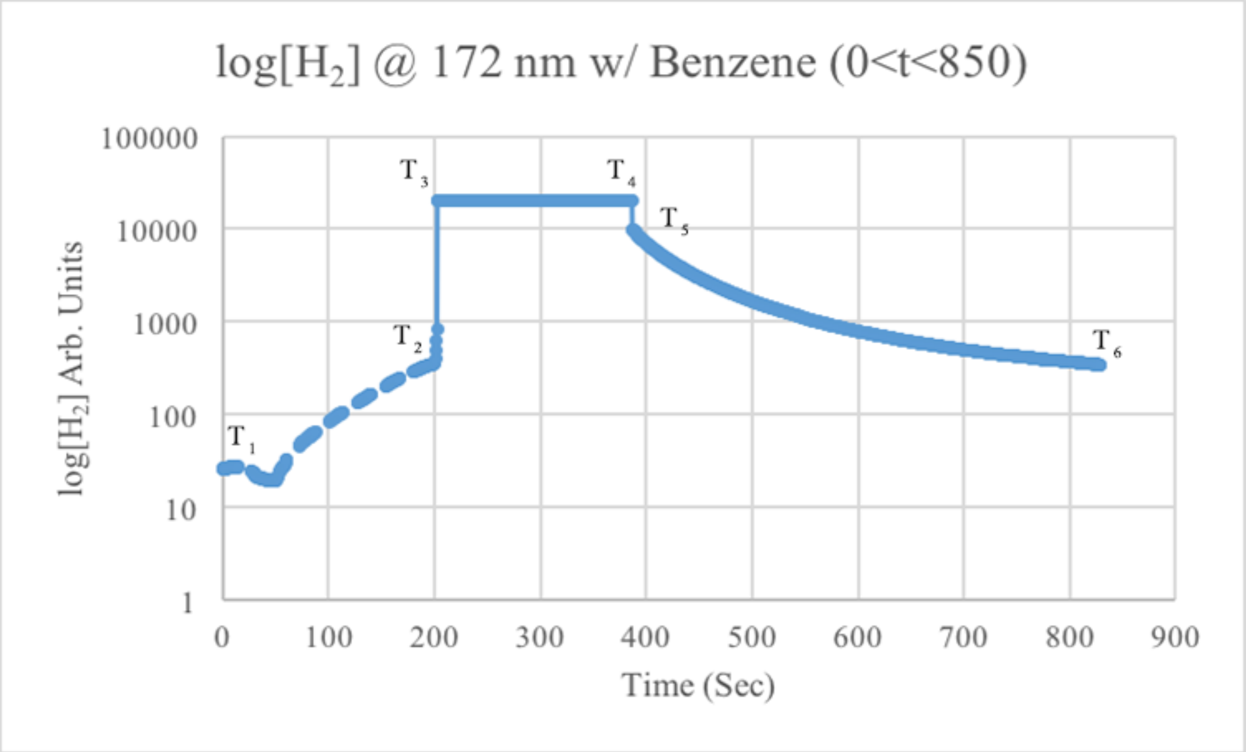

Figure 2;

Hydrogen gas concentration is plotted over time with a variety of different environmental conditions. The region from T_1 -> T_2 is of significant interest and an exploded view is given in figure 3. In this region liquid Benzene was photolyzed at 173 nm VUV and an obvious increase in $[H_2]$ is observed. Explanations of the conditions in the remaining regions are given in table 1.

Table 1

Interval $T_{(i, i+1)}$	Notes
i = 1	Benzene irradiated @ 173 nm.
i = 3	Hydrogen gas injected. Average sensor value over time is plotted.
i = 5	Chamber lid removed and vessel was allowed to vent into outside atmosphere.

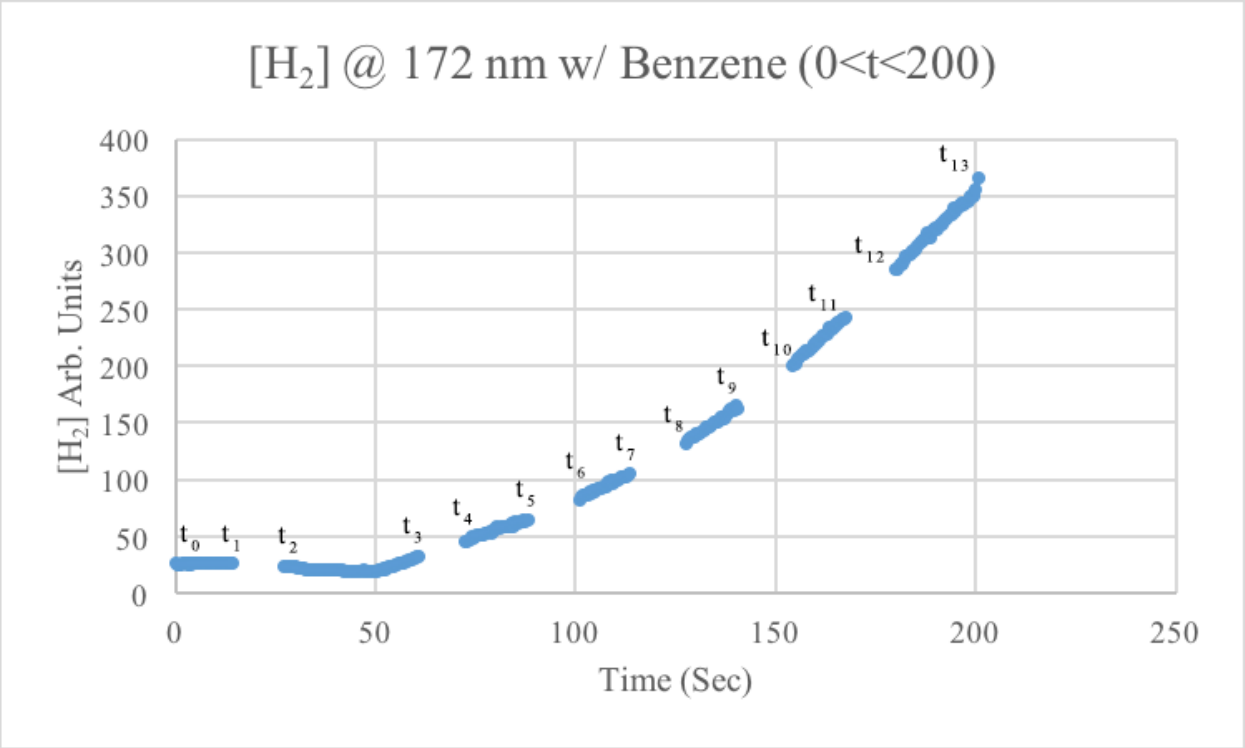

Figure 3;

Hydrogen gas concentration plotted over time. This graph is an exploded view of region T_1 -> T_2, though, note that the y-axis on both figures 1 and 2 is a logarithmic scale whereas figure 3 employs a linear one. The discontinuities in the curve are addressed in the abstract and are a result of some signal attenuation the sensor experienced when the lamp was turned on. These zero-value data points are omitted for clarity. In regions t_0 -> t_1, t_1 -> t_2 & t_2 -> t_3, no Benzene was present in the chamber, though, for t_1 -> t_2 the lamp was turned on to ensure that there was no change in sensor value occurring from Ozone generation. It can be seen that there is no significant change in concentration between regions t_0 -> t_1 & t_2 -> t_3 which indicates that the data collected at $t > \approx 50$ seconds is a result of the Benzene added to the chamber and evolution of H_2. A detailed explanation of the conditions for each region is given in table 2.

Table 2

Interval $T_{(i, i+1)}$	**Notes**
i = 0,2	Light off. No Benzene.
i = 1	Light on. No Benzene.
i = 3,5,7,9,11	Light on w/ Benzene.
i = 4,6,8,10,12	Light off w/ Benzene.