# Vapor Pressure, Iodine Solubility, and Hydrogen Solubility of Hydrogen Iodide-Iodine Solutions 

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#### Abstract

Vapor pressure, lodine solubility, and hydrogen solubility data have been obtained for hydrogen lodide-lodine solutions. The vapor pressure and the lodine solubility of such mixtures have been measured over the temperature range 298-363 K and found to display nearly Ideal behavior. The lodine solubility data fit the normal eutectic-type phase behavior of a two-component system. The hydrogen solublity in pure liquid hydrogen lodide and lodine was found to obey Henry's law.


## Introduction

The data reported in this paper resulted from the need for such data in defining the conditions for a liquid hydrogen iodide decomposition step in a thermochemical water-splitting cycle for hydrogen production (1). Through employment of equipment specifically designed to perform proof of concept catalysis studles, It has been possible to obtain useful data for a chemical system for which data appear to be nonexistent under the conditions studied.

## Experimental Apparatus

The basic apparatus used for the present studies is sketched in Figure 1. A glass vial serves as a $3.4-\mathrm{MPa}$ ( $500-\mathrm{psia}$ ) rated pressure vessel. It is sealed to the metal parts of the system by a stainless-steel adapter that has an elastomer O-ring seal to the glass. The O-ring is a high-temperature perfluorocarbon "Kalrez" elastomer made by Du Pont. The other metal parts (pipes, valves, etc.) are made of stainless steel. The pressure gauge is a Bourdon type, with all wetted parts of stainless steel. Its range is from 100 kPa ( 15 psia ) to $2.1 \mathrm{MPa}(300 \mathrm{psia})$. The zone above the pressure vessel is heated (as shown in Figure 1) to a temperature above that of the constant-temperature bath. This is done to prevent condensation of HI in the metal parts of the system. The gauge was calibrated at a given temperature ( $\sim 410 \mathrm{~K}$ ) and maintained at this temperature for all runs. The gauge callibration held well over the entire measurement range. The gauge was callibrated against a National Bureau of Standards calibrated gauge. The error associated with the pressure measurements is estimated to be about $\pm 1 \%$.

The procedure employed to make up the $\mathrm{HI}-\mathrm{I}_{2}$ solutions for study was as follows: (1) The glass vessel, loaded with a selected amount of $\mathrm{I}_{2}$, was evacuated to about $1 \mathrm{~Pa}(0.01$ torr). (2) The vessel was cooled to liquid- $\mathrm{N}_{2}$ temperature. (3) HI was transferred into the vessel. (4) The source of HI was removed when the desired amount of frozen HI was introduced. (5) The system was then pumped down again to about 1 Pa to remove any hydrogen that may have accompanied the HI . (6) The system was allowed to warm up to the temperature desired for performing the experiment. (7) The mixtures were stirred well to assure good mixing of the components. The particular procedures used in obtaining each of the specific measurements reported herein are contained in the indlwidual discussions of the results below.

## Results and Discussion

Vapor Pressure of $\mathrm{HI}-\mathrm{I}_{2}$ Solutlons. The vapor pressures of different $\mathrm{HI}-\mathrm{I}_{2}$ solutions at different temperatures were
measured by employing the apparatus in Figure 1 and the general procedure for making up solutions as indicated above.

Figure 2 illustrates the measured vapor pressure behavior of $\mathrm{HI}-\mathrm{I}_{2}$ mixtures compared to ideallty. Following standard procedures, ideal curves (dotted lines in Figure 2) are obtained by superposing the expected ideal behavior of each separate pure component according to tis mole fraction. The vapor pressure for $\mathrm{I}_{2}$ is so much les than for HI at the experimental temperatures ( $T \leq 363 \mathrm{~K}$ ) that the ideal pure HI component curve nearly passes through ( 0,0 ) as shown in Figure 2. Pure HI vapor pressure values were obtained from the literature (2). Measurements of pure HI vapor pressures using the present apparatus correlated with the literature values to within $\pm 5 \%$.
The most frultful determination of $\mathrm{HI}-\mathrm{I}_{2}$ mixture ideality was by measurement of the vapor pressure at saturation levels of $\mathrm{I}_{2}$. This approach also supplied the information on $\mathrm{I}_{2}$ solubility in HI discussed later. Figure 2 locates individual points between 297.5 and 363 K . Aside from one point at 342 K , all data are for $\mathrm{I}_{2}$ saturation and represent end points of the vapor pressure change.

The measurements at 318 K and below produced data which could not be distingulshed from ideal behavior. Data taken for 342 and 363 K are somewhat removed from the ideal curves in the positive direction. These deviations would, for regular solutions, indicate endothermic heats of solution of $460 \mathrm{~J} / \mathrm{mol}$ ( $110 \mathrm{cal} / \mathrm{mol}$ ) for 342 K and $268 \mathrm{~J} / \mathrm{mol}(64 \mathrm{cal} / \mathrm{mol})$ for 363 K and would represent, on this basis, only a small deviation from ideality. The heat of solution values have been estimated by assuming ideal entroples of solution.
$I_{2}$ Solubillty in HI Lliquild. As part of the study of vapor pressure behavior discussed above, the $\mathrm{I}_{2}$ solubility in HI was obtained. These measurements were made by utilizing a magnetically actuated glass dipper as depicted in Figure 1. The procedure was as follows: (1) Good mixing of the $\mathrm{I}_{2}$ and HI was assured. This was most effectively done by stirring the mixture of $\mathrm{I}_{2}$ and HI well at a higher-than-run temperature at which there was no lodine saturation. (2) The solution was cooled until $\mathrm{I}_{2}$ solld was visually evident in the bottom of the vessel. (3) The mixture was allowed to stabilize at temperature. (4) The magnetically actuated glass dipper of known volume ( $2.55 \mathrm{~cm}^{3}$ ) was used to remove a sample of the main pressure vessel mixture. (5) Once a sample was obtained, the HI vapor was removed to a water trap outside the pressure vessel, with the $\mathrm{I}_{2}$ remaining behind. This operation was done carefully to prevent loss of $\mathrm{I}_{2}$ from the dipper. (6) Once the HI was removed to atmospheric pressure, the dipper was removed and the $\mathrm{I}_{2}$ dissolved in KI solution and titrated for $\mathrm{I}_{2}$ and HI content. In all cases, negligible amounts of HI were present in the $\mathrm{I}_{2}$ residue. When the $\mathrm{I}_{2}$ weight was obtained, the initial HI weight present in the dipper was calculated from known (2) densities of HI and $\mathrm{I}_{2}$ and an assumption of molar volume additivity. This assumption expects that the $\mathrm{HI}-\mathrm{I}_{2}$ interaction is not strong (i.e., $\Delta V$ of solubility $=0$ which is true for ideal solutions).
The results are shown in Figure 3, where $\mathrm{I}_{2}$ solubility, in terms of the number of grams of $\mathrm{I}_{2}$ in 100 g of $\mathrm{HI}-\mathrm{I}_{2}$ solution, is plotted vs. temperature. This diagram includes all the points measured in the HI vapor pressure experiments plus the pure molten lodine point, which is based on the literature value. Also shown in Figure 3 is a data point for the lowest $I_{2}$ content


Figure 1. Apparatus used to measure vapor pressure, $\mathrm{I}_{2}$ solublility, and $\mathrm{H}_{2}$ solubility of $\mathrm{HI}-\mathrm{I}_{2}$ solutions.


Figure 2. Vapor pressure behavior of $\mathrm{HI} / \mathrm{I}_{2}$ mixtures and comparison with ideallity.
mixture using a sampling tube method. This measurement helps to provide credence for the dipper method. The curved line fitted to the points is actually one section of a standard eutectic curve designating the phase behavior of two-component systems. In Figure 3, the curve represents the interface between a liquid-solid region and a single-liquid region for $\mathrm{HI}-\mathrm{I}_{2}$ mixtures. Since Figure 3 does not proceed to temperatures lower than 298 K , the eutectic point is not yet reached. This point would be below the melting point of $\mathrm{HI}(\sim 222 \mathrm{~K})$.
$H_{2}$ Gas Solubllity in HI and $I_{2}$ Liqulds. The apparatus employed in studying the $\mathrm{H}_{2}$-gas solubility in varlous process mixtures was also that shown in Figure 1. A side tube was simply used to admit the $\mathrm{H}_{2}$ gas. The method which was em-


Figure 3. Solubility of $\mathrm{I}_{2}$ in HI .
ployed (1) supplied the system with regulated $\mathrm{H}_{2}$ gas, (2) maintained a constant partial pressure of $\mathrm{H}_{2}$ and HI at constant temperature until equilibrium was achieved, and (3) measured the amount of $\mathrm{H}_{2}$ dissolved in HI in the fashion outlined below. The run duration chosen was conveniently the time elapsed overnight (typically 15-17 h). The shortest time required to achieve equilibrium was found to be $\sim 2 \mathrm{~h}$ by observing the kinetic effects of stirring.

Assuming a gas pressure vessel in which there are $\eta$ regions of different volumes $V_{l}$, at different temperatures $T_{l}$ but with the same pressure $P$, for an ideal gas

$$
\begin{equation*}
\frac{R \sum_{i=1}^{\eta} \eta_{i}}{P}=\sum_{i=1}^{\eta}\left(\frac{V_{i}}{T_{i}}\right)=c \tag{1}
\end{equation*}
$$

where $R=$ the gas constant in appropriate units, and $\eta_{l}=$ the number of moles of gas ( $\mathrm{H}_{2}$ in this case) in region $/$. The assumption of a constant pressure $P$ between regions is made because negligible thermal transpiration effects result for the high pressures and, consequently, for small mean free paths used in these studies.

The parameter $V_{i} / T_{i}$ is without direct physical meaning, but it tags the different regions involved. In reality, $C$ is a constant if the temperatures in the different regions are kept constant.

Equation 1 an be rewritten as

$$
\begin{equation*}
\frac{R \sum_{i=2}^{n} \eta_{1}}{P}=c-\left(\frac{V_{1}}{T_{1}}\right) \tag{2}
\end{equation*}
$$

where the factor $V_{1} / T_{1}$ is subtracted from both sides of eq 1 . Note that the summation for $\eta_{i}$ now proceeds from $i=2$ only.

The quantity $C$ was measured in a side experiment in which the volume of gas at amblent conditions was obtained for various pressures at system temperature ( $T_{1}, T_{2}, \ldots, T_{i}, \ldots, T_{\eta}$ ). This value was then transformed to represent the number of moles of gas. The average value of $C$ was found to be 0.3402 $\mathrm{cm}^{3} / \mathrm{K}$ for a 303 K bath temperature. This quantity was measured without any liquid in the system.

Using eq 2

$$
\begin{equation*}
\sum_{i=2}^{\eta} \eta_{i}=(P / R)\left[0.3402-\left(V_{L} / T_{\mathrm{L}}\right)\right] \tag{3}
\end{equation*}
$$

where $V_{\mathrm{L}}$ and $T_{\mathrm{L}}$ equal the equivalent volume and the tem-

Table I. $H_{2} / \mathbf{H I}(1)$ Solubility Data for 303 K

| run <br> no. | temp, <br> K | $\mathrm{H}_{2}$ press., MPa | Henry's <br> constant, ${ }^{a}$ <br> MPa | solubility ${ }^{b}$ |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 303.0 | $0.734 \pm 0.007$ | $275_{-15}^{+17}$ | $17.9 \pm 1.0$ |
| 2 | 302.2 | $1.145 \pm 0.011$ | $368_{-14}^{+16}$ | $18.3 \pm 1.0$ |
| 3 | 302.2 | $0.793 \pm 0.008$ | $248_{-12}^{+13}$ | $19.8 \pm 1.0$ |
| 4 | 303.0 | $0.496 \pm 0.005$ | $254_{-13}^{+15}$ | $19.3 \pm 1.0$ |
| 5 | 303.1 | $0.261 \pm 0.003$ | $227_{-10}^{+12}$ | $21.6 \pm 1.0$ |
| 6 | 302.8 | $0.883 \pm 0.009$ | $263_{-14}^{+15}$ | $18.7 \pm 1.0$ |
| 7 | 302.8 | $0.993 \pm 0.010$ | $236_{-11}^{+12}$ | $20.8 \pm 1.0$ |

${ }^{a} K=P_{\mathrm{H}_{2}} / X_{\mathrm{H}_{2}} \cdot{ }^{b}\left(\mathrm{~cm}^{3}\right.$ of $\left.\mathrm{H}_{2}\right) /\left(100 \mathrm{~cm}^{3}\right.$ of $\left.\mathrm{HI}(1)\right)$.
Table II. $\mathrm{H}_{2} / \mathrm{HI}(\mathrm{l})$ Solubility Data for 273 K

| run <br> no. | temp, <br> K | $\mathrm{H}_{2}$ press., MPa | Henry's <br> constant, $a$ <br> MPa | solubility ${ }^{b}$ |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 273 | $1.620 \pm 0.016$ | $294_{-19}^{+21}$ | $16.1 \pm 1.0$ |
| 2 | 273 | $1.200 \pm 0.012$ | $334_{-22}^{+25}$ | $14.1 \pm 1.0$ |
| 3 | 273 | $0.752 \pm 0.007$ | $302_{-19}^{+20}$ | $15.6 \pm 1.0$ |
| 4 | 273 | $0.393 \pm 0.004$ | $296_{-8}^{+30}$ | $15.4 \pm 1.0$ |
| $a K=P_{\mathrm{H}_{2}} / X_{\mathrm{H}_{2}}$. | $b\left(\mathrm{~cm}^{3}\right.$ of $\left.\mathrm{H}_{2}\right) /\left(100 \mathrm{~cm}^{3}\right.$ of $\left.\mathrm{HI}(1)\right)$. |  |  |  |

perature of the region, respectively, that the liquid occupies.
Equation 3 provides the number of moles that exist in the gas phase above the liquid. The total number of moles (including those in the liquid at equilibrium) is obtained by exhausting all gas ( $\mathrm{H}_{2}$ and HI ) to atmosphere and measuring the resulting volume of $\mathrm{H}_{2}$. The number of moles of $\mathrm{H}_{2}$ in the liquid at equilibrium is the difference between the total moles of $\mathrm{H}_{2}$ and the moles of $\mathrm{H}_{2}$ in the gas phase. This quantity (moles in liquid HI ) is put into a form which is directly comparable with literature values. In this case, a modified Ostwald absorption coefficient, which states the $\mathrm{cm}^{3}$ of gas dissolved per $100 \mathrm{~cm}^{3}$ of liquid, was chosen. For noninteractive mixtures, this coefficient is independent of the pressure.

The most sensitive of the measured quantities leading to error in the determination of $\mathrm{H}_{2}$ solubility appears to be pressure. Calibration of the system consists of obtaining the $C$ value described above, which in turn consists of relying on an accurate measurement of the change in pressure resulting from the removal of a given volume of gas at various temperatures from the apparatus. The error associated with pressure measurement is belleved to be about $\pm 1 \%$. Consequently, the error associated with the measurements of $\mathrm{H}_{2}$ solubility reflects this magnitude of error in pressure measurement.
The $\mathrm{H}_{2}$-gas-volume measurements were obtained by water displacement. The $\mathrm{H}_{2}$ solubility in water at room temperature is, according to the literature (ref 3), about $1.89 \mathrm{~cm}^{3}$ of $\mathrm{H}_{2}$ per $100 \mathrm{~cm}^{3}$ of $\mathrm{H}_{2} \mathrm{O}$ at 303 K . Thus, negligible error is expected from this effect. However, corrections to the volume measurements due to the presence of $\mathrm{H}_{2} \mathrm{O}$ vapor in the $\mathrm{H}_{2}$ gas volume above the displaced water had to be taken into account.

The solublity of $\mathrm{H}_{2}$ gas in pure liquid HI at about 303 K was measured. The results are recorded in Table I. The solubility value, based on the modified Ostwald definition, is $19.5 \pm 1.4$ $\mathrm{cm}^{3}$ of $\mathrm{H}_{2}$ per $100 \mathrm{~cm}^{3}$ of HI, and the Henry's law constant ( $K$ $=P_{\mathrm{H}_{2}}\left(X_{\mathrm{H}_{2}}\right)$ is $253 \pm 18 \mathrm{MPa}$. In both cases, the measurement error is quoted in terms of standard deviations. $P_{\mathrm{H}_{2}}$ is the partial pressure of $\mathrm{H}_{2}$, and $X_{\mathrm{H}_{2}}$ is the mole fraction of $\mathrm{H}_{2}$ in the liquid. The correlation with Henry's law (column 4 of Table I and Figure 4) indicates that a strong interaction between the $\mathrm{H}_{2}$ solute molecules does not exist.

The solubility of $\mathrm{H}_{2}$ in HI measured at 273 K is recorded in Table II and in Figure 4. This solubility value is $15.3 \pm 0.8 \mathrm{~cm}^{3}$ of $\mathrm{H}_{2}$ per $100 \mathrm{~cm}^{3}$ of HI and the Henry's law constant is 306


Figure 4. Henry's law for solubility of $\mathrm{H}_{2}$ in liquid HI .
Table III. $\mathbf{H}_{2} / \mathbf{I}_{2}$ (l) Solubility Data for 394 K

| run <br> no. | temp, <br> K | $\mathrm{H}_{2}$ press., MPa | Henry's <br> constant, ${ }^{a}$ <br> MPa | solubility ${ }^{b}$ |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 394.5 | $0.794 \pm 0.007$ | $806_{-168}^{+282}$ | $6.4 \pm 1.7$ |
| 2 | 394.9 | $1.367 \pm 0.012$ | $1579_{-580}^{+170}$ | $3.3 \pm 1.7$ |
| 3 | 393.4 | $1.905 \pm 0.018$ | $1091_{-282}^{+566}$ | $4.7 \pm 1.7$ |
| ${ }^{a} K=P_{\mathrm{H}_{2}} / X_{\mathrm{H}_{2}}$. | ${ }^{b}\left(\mathrm{~cm}^{3}\right.$ of $\left.\mathrm{H}_{2}\right) /\left(100 \mathrm{~cm}^{3}\right.$ of $\left.\mathrm{I}_{2}(1)\right)$. |  |  |  |

$\pm 19 \mathrm{MPa}$. The solubility within the study temperature range is relatively insensitive to temperature. There may be a small increase in solubility with increasing temperature, although the experimental error associated with the measurement method does not allow this conclusion with certainty. Such gas solubility behavior is generally accepted as abnormal, but there are many cases where this effect is reported (ref 4). Applying the correct thermodynamic arguments leads to a heat of solution for $\mathrm{H}_{2}$ in liquid HI that is endothermic by about $4.31 \pm 1.05 \mathrm{~kJ} / \mathrm{mol}$ ( 1.03 $\pm 0.25 \mathrm{kcal} / \mathrm{mol})$. The total pressure limitations of the present apparatus limit the studies to temperatures less than room temperature.
The HI quantity was measured by titration and from the known volume and the literature value for density. Both determinations correlated well.
The solubillty of $\mathrm{H}_{2}$ in liquid $\mathrm{I}_{2}$ was measured at 394 K and three different pressures; the results are recorded in Table III and Figure 5. It is immediately obvious that the error assoclated with this measurement is much higher than that for the case for pure HI. This increased error results from the fact that the solubility of $\mathrm{H}_{2}$ in liquid $\mathrm{I}_{2}$ is significantly lower than that for $\mathrm{H}_{2}$ in HI (about $1 / 4$ that in HI ) and approaches the lower level of detectability of the apparatus. In the present apparatus the total gas volume above the liquid is about $40 \mathrm{~cm}^{3}$, and discerning the disappearance of $5 \mathrm{~cm}^{3}$ into the liquid requires the detection of a change of about $10 \%$ in the total volume of $\mathrm{H}_{2}$ removed from the system at the end of the experiment. This is at the limit of detection of the present experimental setup. To provide more accurate results for such low solubilities, an apparatus possessing a much larger liquid volume to gas volume ratio is required.

The significant difference in the method of measurement of $\mathrm{H}_{2}$ solubility in liquid $\mathrm{I}_{2}$ compared with that of the liquid HI results from the fact that it was not possible to stir the liquid $\mathrm{I}_{2}$ by using a magnetic stirrer because of the unavailability of a dense enough magnetic stir bar. Instead, the following procedure was followed. The charge of crystalline $I_{2}$ placed in the pressure vessel at room temperature was pressurized to the desired


Figure 5. Henry's law for solublity of $\mathrm{H}_{2}$ in liquid $\mathrm{I}_{2}$.
pressure before raising the temperature and melting the $\mathrm{I}_{2}$. This minimized the long-term walting period of $\mathrm{H}_{2}$ diffusion into the liquid $I_{2}$ and assured the achievement of virtual equilibrium conditions over much shorter times.

Although the amount of data obtained was limited, the $\mathrm{H}_{2} / \mathrm{I}_{2}(\mathrm{l})$ solublity data appear to exhibit Henrian behavior, as do the $\mathrm{H}_{2} / \mathrm{HI}$ results. More accurate data obtained by using a bet-ter-designed apparatus would be required to verify this fact.

No detectable HI formation from the reaction of $\mathrm{H}_{2}$ and $\mathrm{I}_{2}$ at 394 K was observed even though this reaction would seem to be favorable because of the existence of a sink for HI by way of dissolution into the liquid $\mathrm{I}_{2}$. There was no detectable pressure increase due to the formation of HI , nor was there any experimental evidence of HI gas dissolution in the water collection system for the $\mathrm{H}_{2}$. This observation is borne out by the experiments performed in decomposing Hquid HI (ref 1). In such a case, a catalyst is found to be required in order to obtain a measurable reaction rate, desplte the fact that again the reaction is favored, in this instance, by the dissolution of $I_{2}$ into the HI Hquid. On the basis of this evidence, not much HI would be expected to be formed during the exposure time of $H_{2}$ to $I_{2}(I)$ in these solubility measurements.

Table IV. $\mathrm{H}_{2} / \mathrm{H}_{2} \mathrm{O}$ Solubility Data for 303 K

| $\begin{aligned} & \text { run } \\ & \text { no. } \end{aligned}$ | temp, K | $\mathrm{H}_{2}$ press., MPa | Henry's constant, ${ }^{a} \mathrm{MPa}$ | solubility ${ }^{6}$ |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 302.9 | $1.978 \pm 0.018$ | $-1.2 \times 10^{5}$ | $-0.12 \pm 1$ |
|  |  |  | $+1.0 \times 10^{5}$ |  |
|  |  |  | $-1.3 \times 10^{5}$ |  |
| 2 | 302.3 | $1.103 \pm 0.010$ | $4.3 \times 10^{3}$ | $3.3 \pm 1$ |
|  |  |  | $+1.8 \times 10^{3}$ |  |
|  |  |  | $-1.0 \times 10^{3}$ |  |
| ${ }^{a} K=$ | $\mathrm{H}_{2} / X_{\mathrm{H}}$ | ${ }^{b}\left(\mathrm{~cm}^{3}\right.$ of $\mathrm{H}_{2}$ | $100 \mathrm{~cm}^{3}$ of $\mathrm{H}_{2} \mathrm{O}$ |  |

A few attempts were made at measuring the solubility of $\mathrm{H}_{2}$ in $\mathrm{H}_{2} \mathrm{O}$ for the purpose of checking out the behavior of the equipment. Table IV presents the results of these attempts. Again, because of the small value expected according to the Iliterature (ref 3), i.e., $1.89 \mathrm{~cm}^{3}$ of $\mathrm{H}_{2}$ per $100 \mathrm{~cm}^{3}$ of $\mathrm{H}_{2} \mathrm{O}$ at 303 K , and the problems with the apparatus in measuring these small quantitites, there is a large variation between the measurements. Nevertheless, the measurements indicate a low value for $\mathrm{H}_{2} / \mathrm{H}_{2} \mathrm{O}$ solubility in the correct range and thus indicate that the higher values obtained for $\mathrm{I}_{2}$ and HI are valid measurements.

## Conclusion

The vapor pressure of $\mathrm{HI}-\mathrm{I}_{2}$ solutions is shown to follow ideal behavior quite closely. This has been established by graphically comparing the experimental data and the theoretically expected behavior for ideal solutions. As well an indication of the endothermic heats of solution for those data showing some deviation are estimated by assuming regular solution behavior. The values of the heats of solution are small.

The solubility of $\mathrm{I}_{2}$ in HI liquid falls on a curve which is one section of a standard curve designating the phase behavior of two-component eutectic systems.

The hydrogen solubility in liquid HI exhibits Henrian behavior at 273 and 303 K . The solubility within this study temperature range is relatively insensitive to temperature having an estimated heat of solution which is endothermic by about $4.31 \pm$ $0.25 \mathrm{~kJ} / \mathrm{mol}$. The solublity of hydrogen in liquid $\mathrm{I}_{2}$ at 394 K also appears to display Henrian behavior although, in this case, the limitations of the measuring method introduce a great degree of uncertainty in the data.

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