# **Hg – Zn** (Mercury – Zinc)

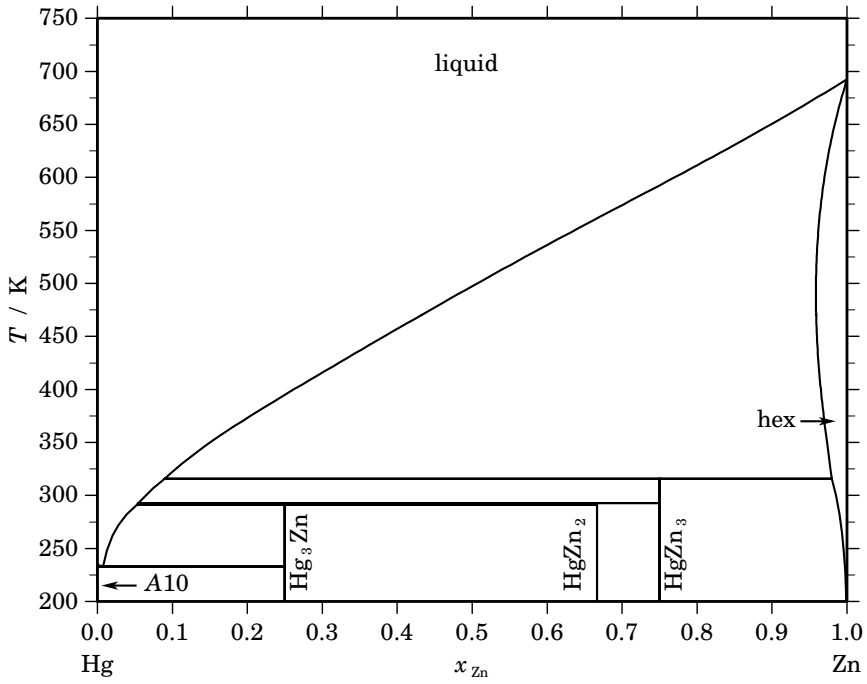


**Fig. 1.** Calculated phase diagram for the system Hg-Zn.

The Hg-Zn system is of interest for the semiconductor industry because of the infrared sensitive tellurides which form a continuous solid solution between HgTe and ZnTe. Reviews on the literature of the Hg-Zn system have been given in [1995Zab, 1998Han] and a thermodynamic dataset has been optimised by [1998Han] which is based on the SGTE recommended element data. The liquidus has been determined throughout the whole composition range already long ago [1903Pus]. More investigations of the liquidus in the Hg-rich region have been reported by [1910Coh] and [1946Pes] who investigated especially the eutectic close to pure mercury. Many other contributions to the liquidus have been reported in the literature and a compilation of these data can be found in the review of [1995Zab]. A wide range of scattered data has been reported in the literature for the solubility of mercury in solid zinc probably due to problems in attaining equilibrium. The most reliable data seem to be given by [1967Tan] since the samples have been equilibrated for up to one year. The solubility of Zn in solid Hg is small and not precisely known. Three intermetallic phases have been found which are all described as stoichiometric compounds in the assessment [1998Han]. Two of them , $HgZn_2$ and $HgZn_3$, seem to have a wider solubility range. From calorimetric investigations of liquid alloys enthalpies of mixing have been reported [1960Kle, 1960Wit]. The assessment takes also into account activity data for Hg in liquid alloys reported in [1912Hil, 1933Ped, 1971Koz].

**Table I.** Phases, structures and models.

| Phase | Struktur-bericht | Prototype | Pearson symbol | Space group | SGTE name | Model |
|---|---|---|---|---|---|---|
| liquid | | | | | LIQUID | $(Hg,Zn)_1$ |
| $A10$ | $A10$ | $\alpha$Hg | $hR1$ | $R\overline{3}m$ | RHOMBO_A10 | $(Hg,Zn)_1$ |
| $Hg_3Zn$ | ··· | ··· | ··· | ··· | HG3ZN | $Hg_3Zn_1$ |
| $HgZn_2$ | ··· | ··· | ··· | ··· | HGZN2 | $Hg_1Zn_2$ |
| $HgZn_3$ | ··· | $\beta$'$Cu_3Ti$ | $oC4$ | $Cmc2_1$ | HGZN3 | $Hg_1Zn_3$ |
| hex | $A3$ | Mg | $hP2$ | $P6_3/mmc$ | HCP_ZN | $Zn_1$ |

**Table II.** Invariant reactions.

| Reaction | Type | $T$ / K | Compositions / $x_{\mathrm{Zn}}$ | | | $\Delta_{\mathrm{r}}H$ / (J/mol) |
|---|---|---|---|---|---|---|
| liquid + hex $\rightleftharpoons$ $HgZn_3$ | peritectic | 315.6 | 0.090 | 0.980 | 0.750 | −1703 |
| liquid + $HgZn_3$ $\rightleftharpoons$ $HgZn_2$ | peritectic | 292.7 | 0.055 | 0.750 | 0.667 | −330 |
| liquid + $HgZn_2$ $\rightleftharpoons$ $Hg_3Zn$ | peritectic | 291.2 | 0.053 | 0.667 | 0.250 | −1157 |
| liquid $\rightleftharpoons$ $A10$ + $Hg_3Zn$ | eutectic | 233.0 | 0.007 | 0.000 | 0.250 | −2341 |

**Table IIIa.** Integral quantities for the liquid phase at 700 K.

| $x_{\mathrm{Zn}}$ | $\Delta G_{\mathrm{m}}$ [J/mol] | $\Delta H_{\mathrm{m}}$ [J/mol] | $\Delta S_{\mathrm{m}}$ [J/(mol·K)] | $G^{\mathrm{E}}_{\mathrm{m}}$ [J/mol] | $S^{\mathrm{E}}_{\mathrm{m}}$ [J/(mol·K)] | $\Delta C_P$ [J/(mol·K)] |
|---|---|---|---|---|---|---|
| 0.000 | 0 | 0 | 0.000 | 0 | 0.000 | 0.000 |
| 0.100 | −1612 | 277 | 2.699 | 280 | −0.004 | 0.000 |
| 0.200 | −2413 | 414 | 4.038 | 500 | −0.122 | 0.000 |
| 0.300 | −2894 | 461 | 4.794 | 661 | −0.285 | 0.000 |
| 0.400 | −3155 | 456 | 5.157 | 762 | −0.438 | 0.000 |
| 0.500 | −3231 | 424 | 5.222 | 803 | −0.542 | 0.000 |
| 0.600 | −3136 | 381 | 5.025 | 781 | −0.571 | 0.000 |
| 0.700 | −2862 | 331 | 4.562 | 693 | −0.517 | 0.000 |
| 0.800 | −2376 | 266 | 3.774 | 537 | −0.387 | 0.000 |
| 0.900 | −1585 | 166 | 2.501 | 307 | −0.202 | 0.000 |
| 1.000 | 0 | 0 | 0.000 | 0 | 0.000 | 0.000 |

Reference states: Hg(liquid), Zn(liquid)

**Table IIIb.** Partial quantities for Hg in the liquid phase at 700 K.

| $x_{\mathrm{Hg}}$ | $\Delta G_{\mathrm{Hg}}$ [J/mol] | $\Delta H_{\mathrm{Hg}}$ [J/mol] | $\Delta S_{\mathrm{Hg}}$ [J/(mol·K)] | $G^{\mathrm{E}}_{\mathrm{Hg}}$ [J/mol] | $S^{\mathrm{E}}_{\mathrm{Hg}}$ [J/(mol·K)] | $a_{\mathrm{Hg}}$ | $\gamma_{\mathrm{Hg}}$ |
|---|---|---|---|---|---|---|---|
| 1.000 | 0 | 0 | 0.000 | 0 | 0.000 | 1.000 | 1.000 |
| 0.900 | −583 | 79 | 0.946 | 30 | 0.070 | 0.905 | 1.005 |
| 0.800 | −1180 | 245 | 2.036 | 119 | 0.180 | 0.816 | 1.021 |
| 0.700 | −1809 | 415 | 3.178 | 267 | 0.212 | 0.733 | 1.047 |
| 0.600 | −2496 | 544 | 4.342 | 477 | 0.095 | 0.651 | 1.085 |
| 0.500 | −3279 | 617 | 5.566 | 755 | −0.197 | 0.569 | 1.138 |
| 0.400 | −4226 | 657 | 6.975 | 1107 | −0.643 | 0.484 | 1.209 |
| 0.300 | −5464 | 719 | 8.833 | 1543 | −1.177 | 0.391 | 1.304 |
| 0.200 | −7293 | 895 | 11.696 | 2075 | −1.686 | 0.286 | 1.428 |
| 0.100 | −10686 | 1308 | 17.134 | 2715 | −2.011 | 0.159 | 1.594 |
| 0.000 | $-\infty$ | 2119 | $\infty$ | 3482 | −1.947 | 0.000 | 1.819 |

Reference state: Hg(liquid)

**Table IIIc.** Partial quantities for Zn in the liquid phase at 700 K.

| $x_{\mathrm{Zn}}$ | $\Delta G_{\mathrm{Zn}}$ [J/mol] | $\Delta H_{\mathrm{Zn}}$ [J/mol] | $\Delta S_{\mathrm{Zn}}$ [J/(mol·K)] | $G^{\mathrm{E}}_{\mathrm{Zn}}$ [J/mol] | $S^{\mathrm{E}}_{\mathrm{Zn}}$ [J/(mol·K)] | $a_{\mathrm{Zn}}$ | $\gamma_{\mathrm{Zn}}$ |
|---|---|---|---|---|---|---|---|
| 0.000 | $-\infty$ | 3663 | $\infty$ | 3096 | 0.810 | 0.000 | 1.702 |
| 0.100 | −10873 | 2059 | 18.474 | 2528 | −0.671 | 0.154 | 1.544 |
| 0.200 | −7342 | 1092 | 12.049 | 2025 | −1.333 | 0.283 | 1.416 |
| 0.300 | −5427 | 568 | 8.563 | 1581 | −1.447 | 0.394 | 1.312 |
| 0.400 | −4143 | 323 | 6.380 | 1190 | −1.239 | 0.491 | 1.227 |
| 0.500 | −3183 | 231 | 4.877 | 851 | −0.886 | 0.579 | 1.157 |
| 0.600 | −2410 | 198 | 3.725 | 563 | −0.522 | 0.661 | 1.102 |
| 0.700 | −1747 | 165 | 2.731 | 329 | −0.234 | 0.741 | 1.058 |
| 0.800 | −1146 | 109 | 1.793 | 152 | −0.062 | 0.821 | 1.027 |
| 0.900 | −573 | 39 | 0.875 | 40 | −0.001 | 0.906 | 1.007 |
| 1.000 | 0 | 0 | 0.000 | 0 | 0.000 | 1.000 | 1.000 |

Reference state: Zn(liquid)

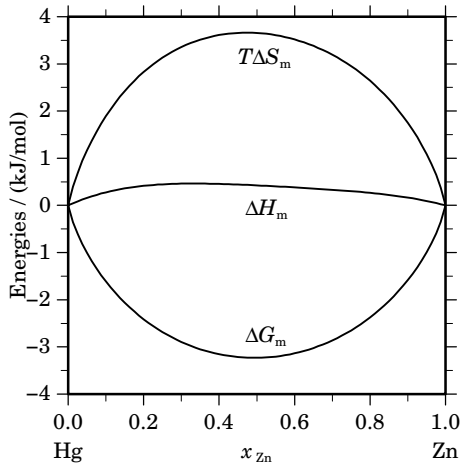


**Fig. 2.** Integral quantities of the liquid phase at $T$=700 K.

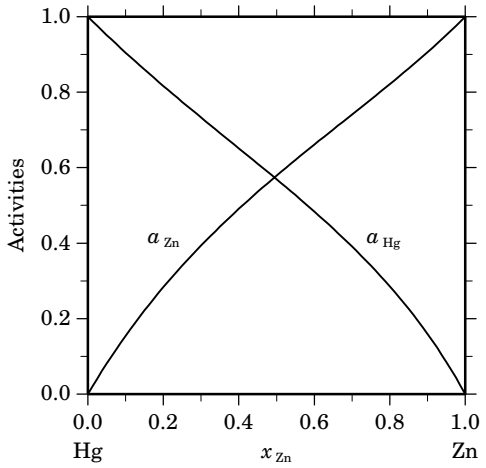


**Fig. 3.** Activities in the liquid phase at $T$=700 K.

**Table IV.** Standard reaction quantities at 298.15 K for the compounds per mole of atoms.

| Compound | $x_{\mathrm{Zn}}$ | $\Delta_{\mathrm{f}}G^{\circ}$ / (J/mol) | $\Delta_{\mathrm{f}}H^{\circ}$ / (J/mol) | $\Delta_{\mathrm{f}}S^{\circ}$ / (J/(mol·K)) | $\Delta_{\mathrm{f}}C^{\circ}_{P}$ / (J/(mol·K)) |
|---|---|---|---|---|---|
| $Hg_3Zn_1$ | 0.250 | −111 | −1255 | −3.835 | 0.003 |
| $Hg_1Zn_2$ | 0.667 | −149 | −1455 | −4.380 | 0.007 |
| $Hg_1Zn_3$ | 0.750 | −158 | −1354 | −4.013 | 0.008 |

## References

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