JPEDAV (2005) 26:81-86
DOI: 10.1361/15477030522590
1547-7037/$19.00 ©ASM International

The Hg-Sr (Mercury-Strontium) System

C. Guminski

Equilibrium Diagram

The assessed Hg-Sr phase diagram (Fig. 1) is a slightly modified form of the diagram of [1974Bru], who studied the system by thermal analysis, metallography, and x-ray diffraction (XRD). The modifications include the deletion of $Hg_{\sim 13}Sr$, the existence of $Hg_{5\text{-}8}Sr$, the shifting of stoichiometry Hg_9Sr_2 to $Hg_{58}Sr_{13}$, and the correction of temperature of the $\alpha \leftrightarrow \beta$ transformation of Sr. Special points of the diagram are presented in Table 1. The Hg-Sr system consists of the following phases: (1) the (Hg) phase with a low solid solubility of strontium; (2) the liquid (L) with boiling denoted by dashed line; (3) the gas (G); (4) nine (or more) intermetallic compounds $Hg_{11}Sr$, $Hg_{5\text{-}8}Sr$, $Hg_{58}Sr_{13}$, $Hg_{51}Sr_{14}$, Hg_3Sr, Hg_2Sr, HgSr, Hg_2Sr_3, $HgSr_2$, and $HgSr_3$; Hg_2Sr and HgSr melt congruently while the rest of the compounds decompose by peritectic reactions; and (5) (αSr) and (βSr) with very low solubilities of Hg.

Boiling

[1930Dev] observed that the Sr amalgam containing 14.75 at.% Sr boiled at 390 °C: pressure was not specified, but presumably was the normal ambient pressure. The further addition of Sr up to 20.5 at.% Sr elevated the boiling temperatures of the amalgam by only several degrees Celsius.

Liquidus

All experimental liquidus results are collected in Table 2. [1974Bru] determined the liquidus points over the whole composition range with the use of the thermal analysis of many Hg-Sr alloys. The alloys were prepared in closed Armco iron capsules that were sealed in an Ar atmosphere. Free volumes over the samples were not reported, and some quantities of Ar were always present inside the capsules. During the performance of the thermal analyses, the pressures were certainly elevated to keep Hg in the liquid state. Due to the strong interaction between Hg and Sr, the partial Hg vapor pressures over the Sr amalgams were significantly lower than those over pure Hg [1974Bru] claimed that the temperatures in their measurements were accurate to ±2 °C. It seems more likely that the experimental precision and accuracy were in fact ±5 °C; there is only rough agreement between their results and those of other investigators in the low-temperature range.

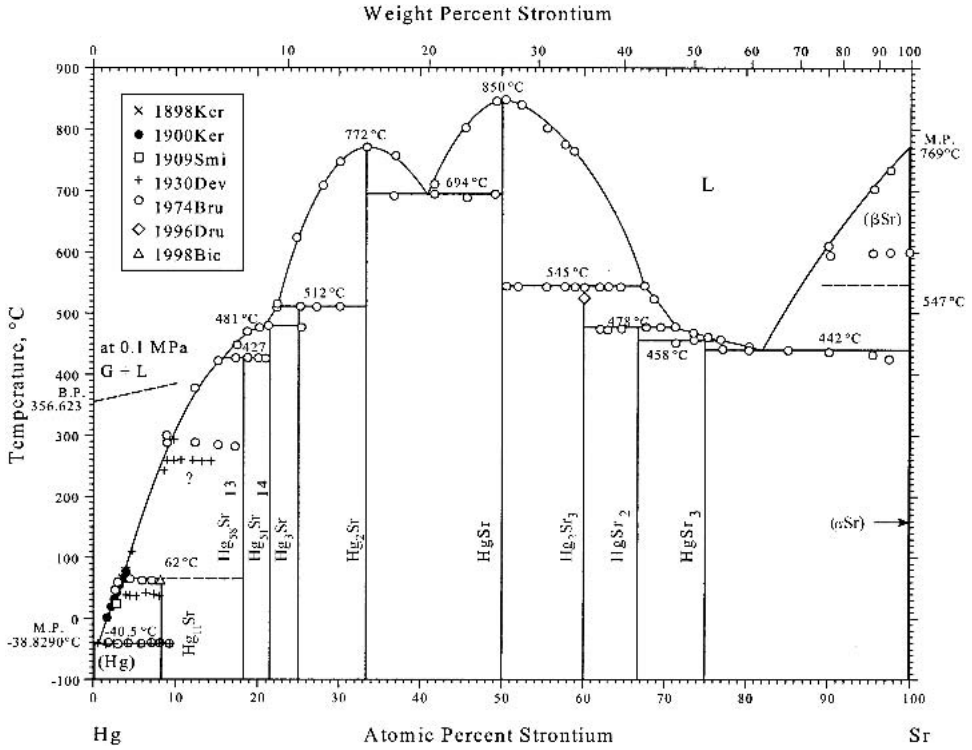

Fig. 1 Assessed Hg-Sr phase diagram at constrained pressure

Table 1 Special points of the assessed Hg-Sr phase diagram

Reaction	Composition of the respective phases, at.% Sr			Temperature, °C	Reaction type
L ↔ Hg		0		−38.8290	Melting point
L ↔ (Hg) + $Hg_{11}Sr$	~0.8	<0.1	8.3	~ −40.5	Eutectic
L + $Hg_{5-8}Sr$ ↔ $Hg_{11}Sr$	3.5	11-17	8.3	62	Peritectic
L + $Hg_{58}Sr_{13}$ ↔ $Hg_{5-8}Sr$	8	18.2	11-17	~285	Peritectic
L + $Hg_{51}Sr_{14}$ ↔ $Hg_{58}Sr_{13}$	16	21.5	18.2	427	Peritectic
L + Hg_3Sr ↔ $Hg_{51}Sr_{14}$	21	25.0	21.5	481	Peritectic
L + Hg_2Sr ↔ Hg_3Sr	22	33.3	25.0	512	Peritectic
L ↔ Hg_2Sr	…	33.3	…	772	Congruent
L ↔ Hg_2Sr + HgSr	40.5	33.3	50.0	694	Eutectic
L ↔ HgSr	…	50.0	…	850	Congruent
L + Hg_2Sr_3 ↔ HgSr	68	60.0	50.0	545	Peritectic
L + $HgSr_2$ ↔ Hg_2Sr_3	72	66.7	60.0	478	Peritectic
L + $HgSr_3$ ↔ $HgSr_2$	77	75.0	66.7	458	Peritectic
L ↔ $HgSr_3$ + (αSr)	82	75.0	>99.9	442	Eutectic
αSr ↔ βSr	…	100	…	547	Allotropic
L ↔ βSr	…	100	…	769	Melting point

Note: all temperatures above the boiling point of Hg are at constrained pressure; temperatures are given as reported.

Table 2 Liquidus data of the Hg-Sr system

Reference	Composition, at.% Sr	Temperature, °C	Reference	Composition, at.%Sr	Temperature, °C
[1898Ker]	3.4	64.7	[1974Bru](a)	22.1	518
	3.6	81		24.8	621
[1900Ker]	1.65	0.0		27.0	708
	2.35	20		30.0	748
	2.85	30		33.3	772
	3.05	46		36.6	757
	3.45	56		41.3	716
	4.00	64.5		45.2	803
	3.7–4.4	81		49.0	846
[1909Smi]	2.5	23		50.3	850
[1930Dev]	1.1	−42.8		52.0	840
	2.5(a)	39		55.2	803
	4.73	110		57.5	777
	8.55	244		58.7	767
	9.8	296		60.0	739
[1974Bru](a)	2.0	43		67.5	544
	3.0	57		68.5	526
	8.7	302		71.2	478
	12.0	377		73.5	470
	15.0	423		75.3	460
	16.8	450		77.0	458
	18.4	472		80.3	448
	20.0	480		90.0	609
	21.0	483		95.2	702
				97.5	735

Note: temperatures are given as reported. (a) Read out from enlarged figures by the evaluator

Earlier, [1930Dev] had also used thermal analysis to investigate the Hg-rich alloys at many compositions between 0.164 and 14.75 at.% Sr. Only five thermal arrests reflecting the liquidus were recorded; they were in accordance with the solubility determinations carried out previously by [1898Ker], [1900Ker], [1909Smi], and [1910Smi]. Two peritectics at ~39 and ~262 °C, and a eutectic at −42.8 °C were well defined in the experiments of [1930Dev], but all of these temperatures are in disagreement with [1974Bru]. The thermocouple outputs reported in [1930Dev] were re-

ferred correctly to the melting and boiling points of Hg, but, unfortunately, these authors used Sr containing up to 2% of impurities. Only the amalgams that were more diluted than 2 at.% Sr were prepared by electrolysis, and these were certainly more pure.

[1898Ker], [1900Ker], [1909Smi], and [1910Smi] measured the solubility of Sr in liquid Hg by means of chemical analysis of the saturated amalgam filtrate. Precise determinations were best achieved near room temperature. Distinct breaks on the liquidus line at ~40 and 62 °C were observed by [1900Ker], thus corroborating the peritectic temperatures found later by [1930Dev] and [1974Bru] respectively.

A predicted hypoeutectic line that was evaluated through the use of the Van't Hoff relation intersects with the extrapolated hypereutectic liquidus data: that of [1974Bru] at ~0.1 at.% Sr and −39.0 °C; that of [1900Ker] at ~0.8 at.% Sr and −40.4 °C; and that of [1930Dev] at ~1.0 at.% Sr and −40.7 °C. Because the data of [1900Ker] seem to be the most reliable in the low-temperature range, the authors adopted a eutectic point in this evaluation of ~0.8 at.% Sr and approximately −40.5 °C.

Solid Solubilities

With the use of XRD, [1974Bru] analyzed the powder patterns of the Sr alloys containing up to 5 at.% Hg. Besides some weak reflections of the Sr_3Hg compound, the main reflections corresponded to (αSr) with the same lattice constant as for the pure metal αSr. This means that the solubility of Hg in solid αSr is negligible. X-ray diffraction (XRD) and metallographic methods showed the absence of solid solubility for the well-defined Hg-Sr intermediate phases.

[1971Ale] analyzed the dependence of the solubility of metals in solid Hg on their position in the periodic table of elements and came to the conclusion that the Sr content in Hg at −40 °C should be not higher than 0.1 at.% Sr. This estimation is in agreement with the assessed phase diagram.

Intermetallic Compounds

Compositions of the intermetallic compounds formed in this binary system have been convincingly established by the following methods: XRD of the alloy powders and single crystals [1954Fer, 1955Duw, 1964Ian, 1970Bru, 1974Bru, 1995Dru, 1996Dru, 1998Bie, 1999Bie], chemical analysis of isolated crystals [1897Gun, 1898Ker, 1900Ker, 1900Lan, 1906Gun, 1930Dev, 1954Fer, 1964Ian, 1970Bru], metallographic analysis [1970Bru, 1974Bru], and thermal analysis of the alloy samples [1930Dev, 1974Bru, 1995Dru, 1996Dru, 1998Bie, 1999Bie]. On this basis, the existence of the following intermetallic compounds was demonstrated: $HgSr_3$ [1974Bru], $HgSr_2$ [1974Bru], Hg_2Sr_3 [1974Bru, 1995Dru, 1996Dru], HgSr [1900Lan, 1954Fer, 1974Bru], Hg_2Sr [1970Bru, 1974Bru], Hg_3Sr [1964Ian, 1974Bru], $Hg_{51}Sr_{14}$ [1974Bru], $Hg_{58}Sr_{13}$ [1974Bru], and $Hg_{11}Sr$ [1897Gun, 1898Ker, 1900Lan, 1906Gun, 1955Duw, 1974Bru, 1998Bie, 1999Bie].

[1995Dru] did not detect Hg_3Sr_5 compound formation in XRD and differential thermal analysis experiments. The peritectic decomposition temperature of Hg_2Sr_3 measured in this laboratory was 20 °C lower than the one observed by [1974Bru], which is probably connected with the fact that Hg_2Sr_3 samples of [1995Dru] and [1996Dru] were sealed under vacuum, whereas the samples of [1974Bru] were sealed under an Ar atmosphere.

There have been several attempts to estimate the composition of the most Hg-rich solid phase that exists in equilibrium with the saturated liquid in the vicinity of room temperature. [1897Gun] already have observed that the crystals directly separated from the heterogeneous amalgam by filtration had the composition $Hg_{\sim 14}Sr$; however, after the appearance of a Hg excess from the amalgam during its centrifugation, the formula for the solid phase changed to $Hg_{\sim 11}Sr$. The latter composition was confirmed in the subsequent studies of [1898Ker], [1900Lan], and [1906Gun]. The investigations of [1900Ker] and [1910Smi] pointed rather to the crystal formula $Hg_{\sim 12}Sr$. [1974Bru] reported, in addition to $Hg_{11}Sr$, the existence of $Hg_{\sim 13}Sr$, but the authors were not able to obtain either its pure crystal form or the proper XRD patterns for evidence. [1998Bie] and [1999Bie] repeated thermal analyses and XRD experiments in the Hg-rich composition range and found irrefutably that $Hg_{11}Sr$ peritectically decomposes at 63 ± 3 °C. These authors also claimed that $Hg_{11}Sr$ is the most Hg-rich and thermodynamically stable compound in the system.

The statements of [1998Bie] and [1999Bie] are in partial agreement with the earlier observations of [1900Ker] that a solid in equilibrium with the saturated liquid at 46 to 81 °C had a composition of $Hg_{7\text{-}8}Sr$. [1906Gun] obtained an Hg_6Sr phase by the vacuum distillation of Hg excess from $Hg_{11}Sr$. A possible formation of $Hg_{\sim 5}Sr$ was reported by [1900Lan] and [1964Ian]. [1930Dev], with the use of thermal analysis, established that the Hg_8Sr compound is stable up to its peritectic decomposition at ~262 °C. If one looks carefully at the phase diagram figure of [1974Bru], one observes the actual decomposition of $Hg_{11}Sr$ at 62 °C (misinterpreted by the authors) and additional thermal arrests spread between 279 and 289 °C, which should belong to a peritectic decomposition of a Hg-poorer, unidentified phase. Thus, one may infer from the existence of an $Hg_{5\text{-}8}Sr$ solid phase that according to the studies of [1930Dev] and [1974Bru] should be stable up to 262 to 289 °C.

Precise compositions of $Hg_{58}Sr_{13}$ and $Hg_{51}Sr_{14}$, denoted earlier as $Hg_{4.5}Sr$ and $Hg_{3.6}$, respectively, were established by means of crystallographic data and the general classification of alloy structures.

Crystal Structures and Lattice Parameters

The crystallographic structures and lattice constants of the Hg-Sr phases are summarized in Tables 3 and 4; respectively. All mentioned intermetallic compounds were prepared and investigated by [1974Bru], who used 99.8% pure Sr and 99.99% pure Hg. The melting points and crystallographic data for the elements were in good agreement with the accepted values of [Massalski2], but the αSr ↔ βSr transformation in the article by [1974Bru] was observed at higher temperature than in [Massalski2]. Therefore, one

Table 3 Hg-Sr crystal structures

Phase	Composition, at.% Sr	Pearson's symbol	Space group	Strukturbericht designation	Prototype
Hg	0	*hR*1	$R\bar{3}m$	*A*10	αHg
$Hg_{11}Sr$	8.3	*cP*36	$Pm\bar{3}m$	*D*2*e*	$BaHg_{11}$
$Hg_{5-8}Sr$	11-17	Unknown	…	…	…
$Hg_{58}Sr_{13}$	18.2	*hP*142	$P6_3/mmc$	…	$Gd_{13}Zn_{58}$
$Hg_{51}Sr_{14}$	21.5	*hP*65	*P*6/*m*	…	$Ag_{51}Gd_{14}$
Hg_3Sr	25	*hP*8	$P6_3/mmc$	$D0_{19}$	Ni_3Sn
Hg_2Sr	33.3	*oI*12	*Imma*	…	$CeCu_2$
HgSr	50.0	*cP*2	$Pm\bar{3}m$	*B*2	CsCl
Hg_2Sr_3	60.0	*tP*10	*P*4/*mbm*	$D5_a$	Si_2U_3
$HgSr_2$	66.7	Unknown	…	…	…
$HgSr_3$	75.0	*oP*16	*Pnma*	$D0_{11}$	CFe_3
αSr	100	*cF*4	$Fm\bar{3}m$	*A*1	Cu
βSr	100	*cI*2	$Im\bar{3}m$	*A*2	W

Table 4 Hg-Sr lattice parameter data at room temperature

Phase	Composition, at.% Sr	Lattice parameters, nm			Comment	Reference
		a	*b*	*c*		
Hg	0	0.3005	…	α = 70.53°	at –48 °C	[Massalski2]
$Hg_{11}Sr$	8.3	0.95099(8)		…	…	[1955Duw]
		0.9510	…	…	…	[1974Bru]
		0.9510(2)		…	…	[1998Bie, 1999Bie]
$Hg_{58}Sr_{13}$	18.2	1.594	…	1.579	…	[1974Bru]
$Hg_{51}Sr_{14}$	21.5	1.378	…	0.9880	…	[1974Bru]
Hg_3Sr	25.0	0.6878	…	0.5097	…	[1964Ian]
		0.6906	…	0.5106	…	[1974Bru]
Hg_2Sr	33.3	0.4934	0.7697	0.8472	…	[1970Bru]
		0.4985	0.7754	0.8550	…	[1974Bru]
HgSr	50.0	0.3930	…	…	…	[1954Fer]
		0.3955	…	…	…	[1974Bru]
Hg_2Sr_3	60.0	0.8877	…	0.4556	…	[1974Bru]
		0.8883(2)		0.4553(1)	…	[1995Dru, 1996Dru]
$HgSr_3$	75.0	0.8523	1.108	0.7405	…	[1974Bru]
αSr	100	0.6084	…	…	…	[Massalski2]
		0.6084	…	…	…	[1974Bru]
βSr	100	0.487	…	…	at >547 °C	[Massalski2]

should consider the indicative contamination of Sr used by [1974Bru]. The purity of the elements used in other studies were: in [1998Bie]: Hg, 99.999%; Sr, 99.95%; in [1995Dru] and [1996Dru]: Hg, 99.99%; Sr, 99%; and in [1954Fer] and [1964Ian]: Hg, 99.9+%; Sr, 99.9+%. The crystal structures of all compounds were determined by the XRD powder method. In all cases, good accord between the observed and calculated intensities of reflections was achieved. The structures of $Hg_{\sim 13}Sr$ and $HgSr_2$ were not established because their XRD photographs were too poor for a structural interpretation.

In the case of $Hg_{11}Sr$, a perfect agreement of "a" parameter from [1955Duw], [1974Bru], [1998Bie], and [1999Bie] was observed. The crystallographic constants for Hg_3Sr, Hg_2Sr, and HgSr in the older articles [1954Fer], [1964Ian], and [1970Bru] were 0.2 to 1% smaller than in [1974Bru]. Because these data were obtained in the same laboratory using materials of similar purity, it seems that the apparatus and procedure used for the determination of lattice constants in [1974Bru] was improved. Hg_2Sr, which was initially assigned to the AlB_2 prototype by [1964Ian], was later found to be of the $CeCu_2$ prototype [1970Bru, 1974Bru].

The structural analysis of Hg_2Sr_3 from a powder sample was confirmed in single-crystal investigations by [1974Bru], [1995Dru], and [1996Dru]. Both results agreed within the experimental errors.

Thermodynamics

Thermodynamic functions for the formation of the infinitely diluted liquid strontium amalgam were derived from the electromotive force measurements of [1974Kor],

Table 5 Partial thermodynamic functions of formation of infinitely diluted Sr amalgams at 25 °C

$\Delta\hat{G}^{ex}_{Sr}$, kJ/mol Sr	$\Delta\hat{H}_{Sr}$, kJ/mol Sr	$\Delta\hat{S}^{ex}_{Sr}$, J/K · mol Sr	Reference
…	−249	…	[1949Bri]
−195.1	−217.6	75.3	[1956Fri]
−192.9	…	…	[1974Kor]
−190.5 ± 0.04	−221.8 ± 0.04	105.1 ± 0.04	[1975Lon]
−190.6 ± 1.5	…	…	[1989Gum]
−203.5	…	…	[1990Kor]

Note: the values are referred to mol of Sr atoms.

[1975Lon], and [1990Kor], as well as from the determinations of equilibrium constant of the reaction $2Na^+ + Sr(Hg) \leftrightarrow 2Na(Hg) + Sr^{2+}$ by [1949Bri] and [1956Fri], who took into account the known thermodynamic functions of formation of Na^+, Na(Hg), and Sr^{2+}. [1989Gum] calculated the $\Delta\hat{G}^{ex}_{Sr}$ from the difference of the selected standard potentials of Sr/Sr^{2+} and $Sr(Hg)/Sr^{2+}$. The results are collected in Table 5.

Because only rough values of the component enthalpies were known in the estimation by [1949Bri], the uncertainty in $\Delta\hat{H}_{Sr}$ may be even higher than ±10%. The precision of the values reported by [1975Lon], especially for $\Delta\hat{H}_{Sr}$ and $\Delta\hat{S}^{ex}_{Sr}$, are too optimistic because the standard potential of Sr/Sr^{2+} is still not known very precisely [1985Tos]. Nevertheless, agreement of the data for $\Delta\hat{G}^{ex}_{Sr}$ from [1974Kor], [1975Lon], and [1989Gum] is acceptable.

[1983Hil] predicted that the integral enthalpy of formation of solid HgSr from solid Sr and liquid Hg would be −61.6 kJ/mol atoms. The estimation was based on the Pauling model using the electronegativity scale of Gordy and Thomas. The procedure seems to be accurate within ±10%. BaHg, HgSr, CaHg, and HgMg form a homologous series of compounds with the same crystal structure and a predominantly ionic character for the bonding.

Suggestions for Future Experimental Research

The following features of the Hg-Sr phase diagram need further investigation to confirm some predictions made in this evaluation:

- Position of the eutectic point on the Hg-rich side
- Peritectic decomposition temperature and precise composition range of the $Hg_{5\text{-}8}Sr$ phase
- Estimation of structures of the intermediate phases $Hg_{5\text{-}8}Sr$ and $HgSr_2$
- Determination of the integral thermodynamic data of formation of the Hg-Sr compounds

References

1897Gun: A. Gunz and J. Feree, Electrochemical Preparation of Strontium Amalgam, *Bull. Soc. Chim. Fr.,* Vol 17, 1897, p 390 (in French) (Equi Diagram; Experimental)

1898Ker: W. Kerp, On the Knowledge of Amalgams, *Z. Anorg. Chem.,* Vol 17, 1898, p 284-309 (in German) (Equi Diagram; Experimental)

1900Ker: W. Kerp, W. Böttger, and H. Iggena, On the Knowledge of Amalgams, *Z. Anorg. Chem.,* Vol 25, 1900, p 1-71 (in German) (Equi Diagram; Experimental)

1900Lan: G. Langbein, Ph.D. dissertation, University of Königsberg, 1900 (in German) (as quoted in [Hansen]) (Equi Diagram; Experimental)

1906Gun: A. Gunz and G. Roederer, Strontium Amalgams, *Bull. Soc. Chim. Fr.,* Vol 35, 1906, p 494-503 (in French) (Equi Diagram; Experimental)

1909Smi: G.M. Smith and H.C. Bennett, The Electrolytic Preparation of the Amalgams of Alkali and Alkaline-Earth Metals, *J. Am. Chem. Soc.,* Vol 31, 1909, p 799-806 (Equi Diagram; Experimental)

1910Smi: G.M. Smith and H.C. Bennett, Additional Notes on the Alkali and Alkaline-Earth Amalgams, *J. Am. Chem. Soc.,* Vol 32, 1910, p 622-626 (Equi Diagram; Experimental)

1930Dev: G. Devoto and E. Recchia, The Sr Amalgam, *Gazz. Chim. Ital.,* Vol 60, 1930, p 688-692 (in Italian) (Equi Diagram; Experimental, #)

1949Bri: E.V. Britzke, A.F. Kapustinskii, V.K. Veselovskii, and L.M. Shamovskii, Sr Compounds, *Termicheskie Konstanty Neorganicheskikh Veshchestv,* Izdatelstvo AN SSSR, Moskva, 1949, p 241 (in Russian) (Therm; Review)

1954Fer: R. Ferro, The Crystal Structure of BaCd, CdSr, BaHg and HgSr, *Acta Crystallogr.,* Vol 7, 1954, p 781 (Equi Diagram, Crys Structure; Experimental)

1955Duw: E.J. Duwell and N.C. Baenziger, The Crystal Structures of KHg and KHg_2, *Acta Crystallogr.,* Vol 8, 1955, p 705-710 (Equi Diagram, Crys Structure; Experimental)

1956Fri: H.L. Friedman and K. Schug, Thermodynamic Properties of Dilute Alkali Metal Amalgams, *J. Am. Chem. Soc.,* Vol 78, 1956, p 3881-3888 (Thermo; Experimental)

1964Ian: A. Iandelli and A. Palenzona, Intermetallic Compounds of Eu with Zn, Cd and Hg, *Atti Accad. Naz. Lincei, Rend. Cl. Sci. Fis. Mat. Nat.,* Vol 37, 1964, p 165-168 (in Italian) (Equi Diagram, Crys Structure; Experimental)

1970Bru: G. Bruzzone, Intermetallic Compounds MX_2 Formed by Ca, Sr and Ba, *Atti Acad. Naz. Lincei, Rend. Cl. Sci. Fis. Mat. Nat.,* Vol 48, 1970, p 235-241 (in Italian) (Equi Diagram, Crys Structure, Experimental)

1971Ale: B.N. Aleksandrov and O.I. Lomonos, On the Solubility of Metals in Solid Hg, *Zh. Fiz. Khim.,* Vol 45, 1971, p 3003-3006 (in Russian) (Equi Diagram; Theory)

***1974Bru:** G. Bruzzone and F. Merlo, The Hg-Sr System, *J. Less-Common Met.,* Vol 35, 1974, p 153-157 (Equi Diagram, Crys Structure; Experimental, #)

1974Kor: V.N. Korshunov and K.B. Khlystova, On Potentials and Activity Coefficients of Amalgams of the Alkaline-Earth Metals in Aqueous Solution at 25 °C, *Elektrohkimiya,* Vol 10, 1974, p 922-924 (in Russian) (Thermo; Experimental)

1975Lon: P. Longhi, T. Mussini, and E. Vaghli, Standard Potentials of Sr Amalgam Electrode and Thermodynamics of Dilute Sr Amalgams, *J. Chem. Thermodyn.,* Vol 7, 1975, p 767-775 (Thermo; Experimental)

1983Hil: K. Hilpert, Prediction of Formation Enthalpies of the Compounds $HgMg_{(s)}$ and $CaHg_{(s)}$, *Ber. Bunsenges. Phys. Chem.,* Vol 87, 1983, p 818-820 (Thermo; Theory)

1985Tos: S. Toshima, Ca, Sr, Ba and Ra, *Standard Potentials in Aqueous Solutions,* A.J. Bard, R. Parsons, and J. Jordan, Ed., Marcel Dekker, 1985, p 710-720 (Thermo; Review)

1989Gum: C. Gumiński, Selected Properties of Simple Amalgams, *J. Mater. Sci.,* Vol 24, 1989, p 2661-2676 (Thermo; Review)

1990Kor: V.N. Korshunov, Equilibrium Potentials of Simple Amalgams, *Amalgam Systems,* Izdatelstvo Moskovskogo Universiteta, Moskva, 1990, p 53 (in Russian) (Thermo; Review)

1995Dru: C. Druska, "Compounds of alkaline earth metals with 2n, Cd and Hg with Cr_5B_3-type of structure or related structures," Ph.D. dissertation, University of Düsseldorf, Germany, 1995 (in German) (Equi Diagram, Crys Structure; Experimental)

1996Dru: C. Druska, T. Doert, and P. Böttcher, Refinement of the Crystal Structure of Hg_2Sr_3, *Z. Anorg. Chem.,* Vol 622, 1996, p 401-404 (Equi Diagram, Crys Structure; Experimental)

1998Bie: E. Biehl, "Amalgams of Alkali Metals," Ph.D. dissertation, University of Siegen, Germany, 1998 (in German) (Equi Diagram, Crys Structure; Experimental)

1999Bie: E. Biehl and H.J. Deiseroth, Preparation, Structural Relations and Magnetism of Amalgams $Hg_{11}M$ (M: K, Rb, Ba, Sr), *Z. Anorg. Chem.,* Vol 625, 1999, p 1073-1080 (in German) (Equi Diagram, Crys Structure; Experimental)

# Indicates the presence of a phase diagram.
* Indicates a key paper.

Hg-Sr evaluation contributed by **C. Gumiński,** Department of Chemistry, University of Warsaw, Pasteura 1, 02093 Warsaw, Poland. This work was supported by ASM International. Literature was searched through 2002. Dr. Gumiński is the Alloy Phase Diagram Program Category Editor for binary mercury alloys.