COMPONENTS:	EVALUATOR:
(1) Scandium; Sc; [7440-20-2] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

There are no experimental data on the solubility of scandium in mercury. Kozin used his semiempirical equations to calculate solubilities of 9.3×10^{-6} (1) and 7.7×10^{-5} (2) at % at 298 K. Further work is needed on this system.

The existence of $ScHg_3$ and ScHg solid phases have been established (3); the liquid amalgam may be in equilibrium with these phases.

References

1. Kozin, L.F. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR*, 1962, *9*, 101.
2. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
3. Laube, E.; Nowotny, H. *Monatsh. Chem.* 1963, *94*, 851.

COMPONENTS:	EVALUATOR:
(1) Yttrium; Y; [7440-65-5] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

There is no experimental determination of the solubility of yttrium in mercury. Kozin calculated solubilities of 1×10^{-6} (1) and 1.6×10^{-5} (2) at % at 298 K. Kirchmayr and Lugscheider (3) reported a general schematic phase diagram for the lanthanide-mercury and Y-Hg systems; the phase diagram shows that the saturated amalgams are in equilibrium with Y-Hg intermetallic compounds. YHg_5 was also identified, but no decomposition temperature was reported (4). The estimated solubilities are about 0.2 at % at 423 K (3), 1 at % at 548 K (5), and 2 at % at 723 K (3). These estimated solubilities clearly need experimental confirmation.

References

1. Kozin, L.F. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR* 1962, *9*, 101.
2. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
3. Kirchmayr, H.R.; Lugscheider, W. *Z. Metallk.* 1966, *57*, 725.
4. Laube, E.; Kusma, I.B. *Monatsh. Chem.* 1964, *95*, 1504.
5. Kirchmayr, H.R.; Jangg, G. *Monatsh. Chem.* 1965, *96*, 1147.

COMPONENTS:	EVALUATOR:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

Parks and Campanella (1) were the first to analytically determine the solubility of lanthanum in mercury; these authors reported that the solubilities increased from 8.0×10^{-3} to 2.64×10^{-2} at % in the temperature range of 273 to 323 K. Shvedov et al. (2) reported a solubility at 293 K which was sixfold higher than that reported by (1); the amalgam in (2) probably was not in equilibrium and the graphiçal procedure of the solubility determination from polarographic experiment is questionable. The result of (2) is rejected. More recent works of Zebreva et al. (3,7,12,13), from chronoamperometric oxidation of the amalgams, confirm the results of (1). Zebreva et al. found that the solubility increased from 1.8×10^{-2} to 4.0×10^{-2} at % at 298 to 333 K. Bowersox and Leary (14) determined the solubility at 293, 423 and 523 K by chemical analysis, and although the value at 293 K appears too high, the values at the higher temperatures agree well with those obtained from the extrapolation of the results of (1), (7) and (12). In the high temperature range of 531 to 1351 K the solubility of lanthanum may be obtained from the liquidus curve of the La-Hg phase diagram which was determined by thermal analysis by Bruzzone and Merlo (6). However, the solubilities obtained from the liquidus are approximately one order of magnitude higher than those expected on the basis of solubilities determined at lower temperatures. Kozin's calculated solubility of 3.8×10^{-2} (4) and 5.4×10^{-2} at % (5,8) at 298 K are too high.

The saturated amalgams are in equilibrium with various La-Hg solid phases (6,9-11). Partial phase diagrams have been reported by (6) and (9), but these diagrams are not directly comparable because they were determined at different mercury vapor pressures; Fig. 1 shows that of (6).

The tentative values of the solubility of La in Hg:

T/K	Soly/at %	Reference
273	8×10^{-3}	(1)
298	1.4×10^{-2}	(1)
323	2.6×10^{-2}	(1)
423	0.25	(14)
523	0.4	(14)

COMPONENTS:	EVALUATOR:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

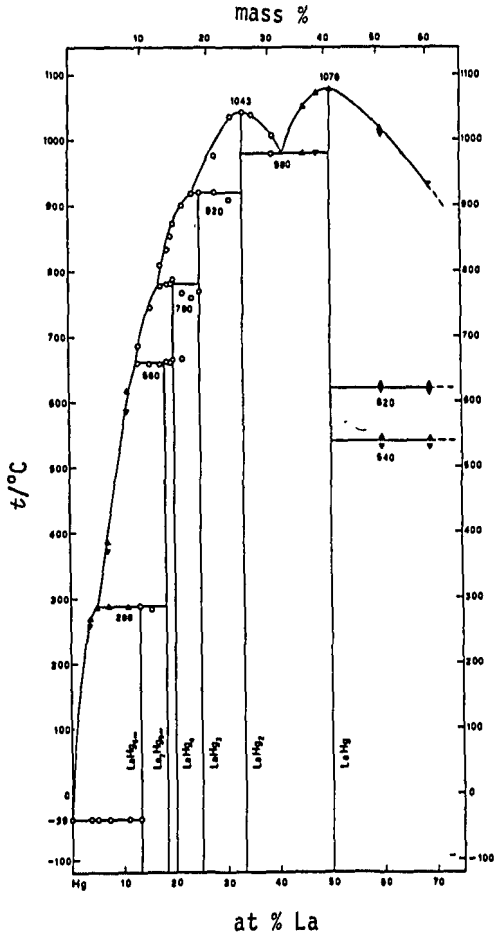

Fig. 1. The La-Hg system (6).

References

1. Parks, W.G.; Campanella, J.L. *J. Phys. Chem.* 1936, *40*, 333.
2. Shvedov, V.P.; Frolkov, A.Z.; Nikishin, G.D. *Radiokhimia* 1971, *13*, 252.
3. Bulina, V.A.; Zebreva, A.I.; Enikeev, R.Sh. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.* 1977, *20*, 959.
4. Kozin, L.F. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR.* 1962, *9*, 101.
5. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
6. Bruzzone, G.; Merlo, F. *J. Less-Common Metals* 1976, *44*, 259.
7. Sagadieva, K.Zh.; Zebreva, A.I.; Zheldybaeva, B. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.* 1973, *16*, 47.
8. Kozin, L.F. *Vestn. Akad. Nauk Kaz. SSR*, 1972, No. 3, 34.
9. Kirchmayr, H.R.; Lugscheider, W. *Z. Metallk.* 1966, *57*, 725.
10. Flad, D.; Matthes, F. *Z. Chem.* 1964, *4*, 466.
11. Merlo, F.; Fornasini, M.L. *J. Less-Common Metals* 1979, *64*, 221.
12. Sagadieva, K.Zh.; Dzholdasova, R.M.; Zebreva, A.I. *Uspekhi Polarografii s Nakopleniem*, Tomsk, 1973, p. 104.
13. Sagadieva, K.Zh.; Badavamova, G.L.; Zebreva, A.I. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1982, No. 2, 59.
14. Bowersox, D.F.; Leary, J.A. *U.S. At. Ener. Comm. Rep., LAMS-2518*, 1961.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	Parks, W.G.; Campanella, J.L. *J. Phys. Chem.* 1936, *40*, 333-41.
VARIABLES: Temperature: 0-50°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of lanthanum in mercury.

t/°C	Soly/mass %[a]	Soly/at %[b]
0	$(5.52 \pm 0.08) \times 10^{-3}$	7.97×10^{-3}
12.5	$(9.07 \pm 0.06) \times 10^{-3}$	1.30×10^{-2}
25	$(9.60 \pm 0.06) \times 10^{-3}$	1.38×10^{-2}
37.5	$(1.34 \pm 0.04) \times 10^{-2}$	1.92×10^{-2}
50	$(1.84 \pm 0.05) \times 10^{-2}$	2.64×10^{-2}

[a] original data.

[b] corrected at % by compilers.

The authors state that at % was calculated from mass % by the graphical method described by Ölander (1) and checked by an analytical computation, but the compilers found that there is a mistake in the at % reported in this paper. The empirical formula of the solid phase in equilibrium with the saturated amalgam at 25°C was reported to be La_2Hg_{11}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Amalgams were prepared by electrolysis of concentrated solutions of $LaBr_3 \cdot H_2O$ in absolute ethanol or by the dissolution of an appropriate amount of lanthanum in mercury. The heterogeneous amalgams in quartz flasks were placed in a water thermostat at desired temperatures and shaken at intervals for several days. Amalgams were filtered into a special filter pipette, which was also thermostated, by means of a vacuum pump. After weighing of the samples they were set aside in contact with air for 2 weeks. La(III) hydroxide, with some basic carbonate over the mercury phase, was treated with known amount of 0.1 mol dm^{-3} HCl. The excess of acid was back titrated with NaOH.

SOURCE AND PURITY OF MATERIALS:

Mercury was purified by stirring for 3 days with solution of HNO_3-$Hg_2(NO_3)_2$ then redistilled 4 times, with last distillation under high vacuum.
La, $LaCl_3$, HBr and oxalic acid were chemically pure; oxalic acid recrystallized 3 times.
Commercial, 95% ethanol distilled several times after treatment with lime and sodium.

ESTIMATED ERROR:

Soly: precision better than ± 2%.

Temp: precision ± 0.1 K.

REFERENCES:

1. Ölander, A.
Ind. Eng. Chem., Anal. Ed. 1932, *4*, 438.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	Bowersox, D.F.; Leary, J.A. *U.S. At. Ener. Comm. Rep., LAMS-2518*, 1961.
VARIABLES: Temperature: 20-250°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubilities of lanthanum in mercury.

t/°C	g La/dm^3 Hg	at %[a]
20	2.87[b]	3.1×10^{-2}
150	22.9	0.25
250	37.0	0.41

[a] by compilers.

[b] The result at 20° is too high.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Hg was outgassed in a reaction vessel at 250°C then cooled to room temperature. A weighed La coupon was added and the vessel was backfilled with He. The evacuation and backfilling of the vessel with He were repeated several times. The mixture of the metals was equilibrated for 24 hr at 350°C, then the vessel was adjusted to the selected temperature. The samples were drawn through a coarse Pyrex frit at intervals of 5 to 90 hr. Each sample was cooled, weighed and analyzed for La content. The procedure gives good results when the filtration is carried out at least 20 hr after adjusting the selected equilibration temperature.

SOURCE AND PURITY OF MATERIALS:

Triple distilled Hg was used.

Lanthanum purity not specified.

ESTIMATED ERROR:

Soly: precision better than ± 2%.

Temp: not specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	Sagadieva, K.Zh.; Zebreva, A.I.; Zheldybaeva, B. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.* 1973, *16*, 47-50.
VARIABLES: Temperature: 25-60°C	PREPARED BY: C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of lanthanum in mercury at various temperatures is reported.

t/°C	Soly/mol dm^{-3}	Soly/at %[a]
25	$(1.2 \pm 0.1) \times 10^{-2}$	1.8×10^{-2}
30	1.5×10^{-2}	2.2×10^{-2}
40	1.8×10^{-2}	2.7×10^{-2}
50	2.1×10^{-2}	3.1×10^{-2}
60	2.7×10^{-2}	4.0×10^{-2}

[a] by compilers

The same results were reported in (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The amalgams were obtained by reduction of La(III) solution with sodium amalgam. Composition of amalgam was established by analysis of solution before and after reduction. The constantly mixed amalgams were then oxidized at -0.10 V vs. SCE and current-time dependences were recorded. The point of transition from a homogeneous to heterogeneous amalgam was determined from the breakpoint in the current-time curve. Concentration of the saturated amalgam was calculated from the charge corresponding to the oxidation of the homogeneous amalgam. Measurements were performed under a hydrogen atmosphere.	Nothing specified.
	ESTIMATED ERROR: Soly: precision approximately ± 10%. Temp: precision ± 0.5 K.
	REFERENCES: 1. Sagadieva, K.Zh.; Dzholdasova, R.M.; Zebreva, A.I. *Uspekhi Polarografii s Nakopleniem*, Tomsk, 1973, pp. 104-5.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	Bruzzone, G.; Merlo, F. *J. Less-Common Metals* 1976, *44*, 259-65.
VARIABLES: Temperature: 258-1078°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Data were reported as a phase diagram. The solubility of lanthanum was read from the liquidus data points by the compilers.

t/°C	Soly/at %	t/°C	Soly/at %
258-268	3.5	976	28.0
288	5.0	1033	31.0
371-383	7.0	1043	33.3
587-615	11.0	1038	35.2
686	13.2	1004	39.1
744	15.8	980	41.0
810	17.7	1052	45.0
833	18.7	1071	47.5
852	19.5	1078	50.0
872	20.0	1008-1016	60.0
901	21.8	932	69.1
920	23.5		

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Appropriate quantities of the two metals were sealed in iron crucibles, for alloys of 0-15% La, and in tantalum crucibles enclosed in iron containers, for alloys of greater than 15% La. Thermal analysis by heating and cooling curves were made with Chromel-Alumel thermocouples. For alloys with less than 15 at % La, thermal analysis was also made at temperatures below 0°C with iron-constantan thermocouples. X-ray analysis was also made on the solid phases.

SOURCE AND PURITY OF MATERIALS:

Lanthanum was 99.6% pure from Koch-Light Labs.
Mercury was a commercial product of 99.99% purity.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: accuracy ± 5 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lanthanum; La; [7439-91-0] (2) Mercury; Hg; [7439-97-6]	1. Bulina, V.A.; Zebreva, A.I.; Enikeev, R.Sh. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.* 1977, *20*, 959-61. 2. Sagadieva, K.Zh.; Badamova, G.L.; Zebreva, A.I. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1982, No. 2, 59-61.
VARIABLES:	PREPARED BY:
One temperature: 25°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of lanthanum in mercury at 25°C was found to be $(1.1 \pm 0.2) \times 10^{-2}$ and 1.17×10^{-2} mol dm^{-3}, respectively, in (1) and (2). The respective atomic % solubility calculated by the compilers are 1.6×10^{-2} and 1.73×10^{-2} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Heterogeneous amalgam in (1) was potentiostatically oxidized at -0.3 V vs. SCE in acetate buffer of pH 3.0. The current-time curve attained a plateau at saturation, and the solubility was calculated from the charge consumed for the oxidation to the breakpoint in the i-t curve. In (2) the amalgam was obtained by reduction of La(III) with Na amalgam; La concentration in amalgam determined by analysis of solution before and after reduction. Amalgam then oxidized chronoamperometrically, at various periods after amalgam preparation, at -0.10 V vs. SCE in an unmixed, buffered acetate solution of 1 mol dm^{-3}. Limiting current, i_d, obtained from current-time curves. Solubility determined from breakpoint in plots of i_d vs. La concentration in amalgam. i_d was constant for amalgams equilibrated over 90 minutes at fixed amalgam concentration.	Nothing specified.
	ESTIMATED ERROR: Soly: precision 10-20% (compilers). Temp: precision $\pm$ 0.5 K.
	REFERENCES: