Letters

On the thermal behaviour of silver amalgams

Recently, Sake Gowda *et al.* [1] have investigated the effect of elevated temperatures on the lattice parameter of β phase silver amalgams (AgHg). They report a lattice expansion of the β phase to 85° C, a co-existence of the α and β phases from 85 to 125° C, and a complete transformation to the α phase near 125° C. The lattice parameter, a, of the α phase then decreases with increasing temperature to ~250° C. It was postulated that this decrease of a was probably the result of the evaporation of Hg in the silver amalgam. The purpose of this note is to demonstrate that the thermal behaviour of silver amalgams observed by Sake Gowda *et al.* [1] is consistent with the idea of Hg evaporation and also with the phase diagram.

Several years ago the present author published the results of an investigation on phase transformations in amalgams using X-ray diffraction and weight loss data as a function of time [2]. The detailed experimental procedure will not be reproduced here; in brief, Ag_2Hg_3 (γ) samples of a known weight were heated in an oven at 70° C then removed at various times, weighed to determine the Hg lost, and an X-ray diffraction analysis performed. It was found that with increasing time the samples lost weight due to the evaporation of Hg and that there was a transformation from the $\gamma \rightarrow \alpha$ phase after five weeks. The results are summarized in Table I. It should be noted that the phases present at a particular time as determined by X-ray diffraction were consistent with the Hg lost data when these data were related to the phase diagram.

TABLE I Summary of phase transformation data in Ag_2Hg_3 heated at 70° C.

Weeks heated	wt % Hg*	Phase(s)†
0	70	γ
1	66	$\gamma + \beta$
2	64	$\gamma + \beta$
3	62	$\gamma + \beta$
5	50.8	α

*Determined from weight loss data and represents the wt % Hg remaining in the sample at a particular time.
†From X-ray diffraction analysis.

In view of the above-mentioned results, the observations of Sake Gowda *et al.* [1] can be explained on the basis of Hg evaporation. As the temperature of their β phase silver amalgam is increased, Hg begins to evaporate; by 85° C a sufficient amount of Hg has evaporated to force the sample into the two-phase $\alpha + \beta$ region of the phase diagram. On the basis of these results [1] and the Ag–Hg phase diagram [3], one concludes that the Hg content of the silver amalgam for $23 \leqslant T \leqslant 85$° C is 59 to 61 wt% ($\beta$ phase region) while it is 51 to 59 wt% for $85 < T < 125$° C. At 125° C only the α phase remains, thus, it can be deduced that the sample now contains < 51 wt% Hg. Above this temperature Hg continues to evaporate giving rise to the decrease in lattice parameter until near 250° C the decreasing lattice parameter due to Hg evaporation is overwhelmed by the effect of expansion of the silver lattice (containing a small amount of substitutional Hg) itself, and thus the lattice parameter begins to increase.

In summary the observations of Sake Gowda *et al.* on the thermal behaviour of silver amalgams can be explained by evaporation of Hg from their samples and are consistent with the phase diagram. An estimate of the Hg content over different temperature ranges is provided.

References

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C. L. REYNOLDS JR*
Department of Physics and Materials Research Laboratory,
University of Illinois at Urbana, Champaign,
Urbana, Illinois 61801, USA

*Present address: Union Carbide Corporation, Indianapolis, Indiana 46224, USA.