Reply to comment on `The lattice contraction of nanometre-sized Sn and Bi particles produced by an electrohydrodynamic technique'

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REPLY

Reply to comment on 'The lattice contraction of nanometre-sized Sn and Bi particles produced by an electrohydrodynamic technique'

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Professor Stoneham thinks that the contraction of nm-sized Sn and Bi particles appears to be dominated by the effects of surface stress. According to the equation given by Professor Stoneham:

$$\Delta V/V = -2\beta\sigma/R$$

the lattice contraction for nm-sized Sn and Bi particles are calculated and compared with the experimental values, as shown in tables 1 and 2.

Table 1. Lattice contraction of nm-sized Sn particles with different grain sizes.

Sample	A	B	C	D	E	F
d (nm)	9.2	14	17	22.5	28.5	31.8
$(DV/V)_{cal.}$ (%)	−0.40	−0.26	−0.22	−0.16	−0.13	−0.12
$(DV/V)_{exp.}$ (%)	−0.36	−0.26	−0.21	−0.08	−0.04	−0.01

Table 2. Lattice contraction of nm-sized Bi particles with different grain sizes.

Sample	A	B	C	D	E	F
d (nm)	8.9	13.2	16.8	21.6	26.9	33.2
$(DV/V)_{cal.}$ (%)	−0.61	−0.41	−0.32	−0.25	−0.20	−0.16
$(DV/V)_{exp.}$ (%)	−0.66	−0.43	−0.22	−0.14	−0.08	−0.03

We can see from tables 1 and 2 that the surface stress has a definite effect for lattice contraction of nm-sized particles in agreement with Professor Stoneham's conclusion. It can also be seen, however, that when the mean grain size for Sn particles is 31.8 nm, the calculated contraction value is 0.12%, but the experimental value is close to zero. If the effect of surface stress on lattice contraction is dominant, it is difficult to explain the experimental results. Similar conclusions can be drawn from table 2.

Therefore, the authors think that the lattice contraction of nm-sized Sn and Bi particles is a combined effect of both the supersaturation of vacant lattice sites and the surface stress, and the supersaturation of vacant lattice sites at larger particle size is the dominant mechanism.

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