

Short Communications

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The identification of close-packed hexagonal nickel textures in nickel electrodeposits.

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The observation (in nickel electrodeposits) of textures corresponding to a c.p.h. form of nickel has been reported by many authors (Banerjee & Goswami, 1959*a, b*; Evans & Hopkins, 1952; Yang, 1950). These textures, which generally occur along with an f.c.c. nickel $\langle 211 \rangle$ texture, certainly arise from a substance with a c.p.h. structure and with the observed lattice parameters. It is the purpose of this communication to suggest that there are firm grounds for exercising a certain caution in identifying the substance as c.p.h. nickel.

The basis for this caution is as follows: (1) Even standard compilations of structure-data report considerably differing values for c.p.h. nickel. Wyckoff (1948) and Pearson (1956) report $a=2.65$ and $c=4.32$ Å; whereas Neuberger (1933) gives $a=2.49$ and $c=4.08$ Å. (2) The workers who report c.p.h. nickel in nickel electrodeposits have based their identification on the agreement of their lattice parameters ($a=2.49_5$ Å and $c=4.07_8$ Å) with those given by Neuberger for a c.p.h. nickel. (3) It should be noted, however, that the c.p.h. modification of cobalt has lattice constants (Hofer & Peebles, 1947), $a=2.50$ and $c=4.07$ Å, which are very close to those of the substance identified (generally from fairly diffuse arcs) as c.p.h. nickel. (4) The need to consider the possibility of the presence of cobalt arises because (a) cobalt is invariably present as an impurity in nickel salts and anodes (Zentner, Brenner & Jennings, 1952), and (b) even prolonged low current-density electrolysis does not remove cobalt completely from the bath (as shown by Zentner *et al.*, 1952, p. 112). Low-current-density electrolysis has not always been carried out in studies on the textures of nickel deposits, and those who have adopted this purification technique have not used it for a sufficiently long period of electrolysis. (5) It is known that cobalt co-deposition does not occur to the same extent under all conditions (Fink & Kihough, 1930; Young & Gould, 1936). The co-deposition of cobalt is favored, for instance, by high temperature, high pH, rotation of the cathode, *etc.*, and under many of these conditions c.p.h. nickel has been reported. (6) Cobalt has a lower hydrogen overvoltage, and a higher heat of hydrogen adsorption, when compared with nickel. Hence, when cobalt co-deposition occurs, the surface coverage (with adsorbed hydrogen atoms) must increase to values much greater than those obtained with a pure nickel surface.

The author has proposed a theory for the mechanism of texture development in nickel electrodeposits, in

which adsorbed hydrogen atoms play a crucial role in the selective formation and preferential alignment (normal to the substrate) of facets of a particular type — the zone-axis $\langle uvw \rangle$ of these $\{hkl\}$ facets constituting the texture axis. An increase in hydrogen coverage — it was suggested — leads to selective development of facets of lower population density due to differential adsorption of hydrogen. The changes considered, with any factor that increases hydrogen coverage, were: $\{111\} \rightarrow \{100\} \rightarrow \{110\} \rightarrow \{211\}$ which correspond on the basis of the theory to the texture sequence: $\langle 110 \rangle \rightarrow \langle 100 \rangle \rightarrow \langle 210 \rangle$.

When cobalt is co-deposited, the hydrogen coverage should increase further, and it is likely that facets with still lower population density may develop, *e.g.* $\{210\}$ which corresponds to a $\langle 211 \rangle$ texture for nickel. It may be noted, that precisely this $\langle 211 \rangle$ nickel texture is *always* observed along with the 'c.p.h. nickel' preferred orientation.

It may be concluded, therefore, that the c.p.h. substance reported in nickel electrodeposits has yet to be unequivocally identified as c.p.h. nickel.

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