

quite different from that where processes competing with fluorescence emission are observed⁶.

This work was supported by a grant from the U.S. Office of Naval Research, *NONR-551* (46).

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METALLURGY

Influence of Pre-plated Coatings on the Morphology of the Intermetallic Layer in Tinplate

In the manufacture of electrolytic tinplate, a tin coating is electro-deposited directly on to steel. The plated strip is then heated to above the melting point of tin (232° C) and quenched in water. During this treatment cycle a layer of the intermetallic compound FeSn₂ (about 0.15μ thick) is formed at the steel-tin interface¹.

The intermetallic compound has been shown to have an important influence on the protective value of the coating, particularly with certain canned foods^{2,3}. Recent work⁴ has also shown that protection is enhanced by more complete coverage of the steel by the intermetallic compound and that the degree of coverage may be associated with the morphology of the FeSn₂ crystallites.

The extent to which complete coverage is achieved depends primarily on the number of nucleation sites for the compound crystallites since, under normal manufacturing conditions, the time available for crystal growth is less than about 3 sec. Under such conditions the crystallites appear as a network of prisms, generally arranged in colonies which correspond epitaxially to the grain directions of the ferrite substrate.

G. G. Kamm *et al.*⁵ have suggested that nucleation of compound crystallites is hindered by the presence of surface oxides on the steel prior to plating and have proposed reducing this by pre-plating with tin from an alkaline electrolyte. Complex heat-treatment cycles may also have the effect of modifying the crystal structure of the compound⁶⁻⁸.

As part of an investigation in progress at the Tin Research Institute, it has now been found that the

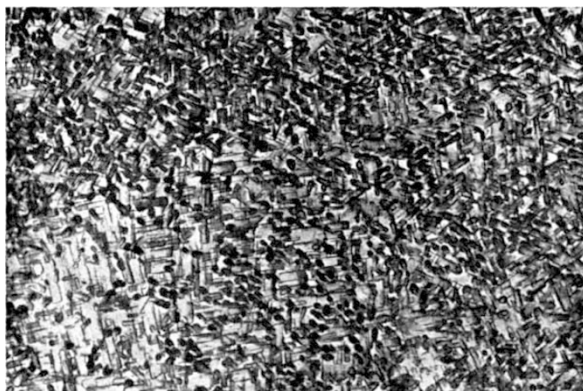


Fig. 1. Intermetallic compound—no undercoat ($\times 6,000$)

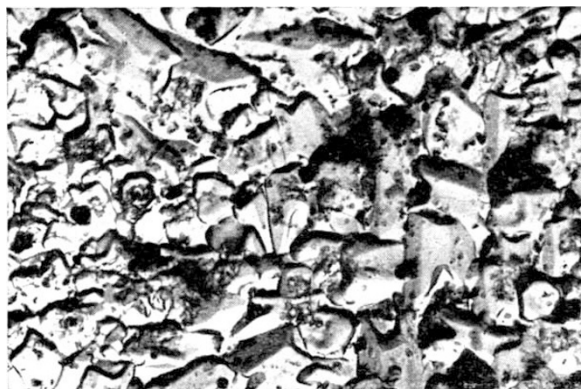


Fig. 2. Intermetallic compound—steel pre-plated with tin-nickel ($\times 6,000$)

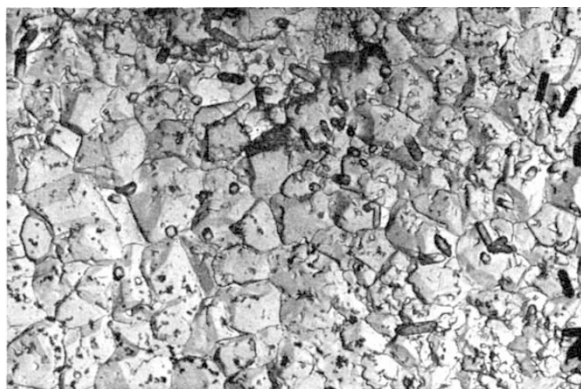


Fig. 3. Intermetallic compound—steel pre-plated with nickel ($\times 6,000$)

nucleation characteristics and the crystal habit of the intermetallic compound on tinplate can be markedly influenced by pre-plating the steel with an extremely thin coating of another metal or alloy. The range of undercoating materials studied included iron, lead, tin-nickel, nickel and palladium, but the most significant results were achieved with electro-deposited tin-nickel alloy and nickel.

In contrast to the normal type of compound layer formed when no undercoat is used (Fig. 1), the presence of a tin-nickel or nickel undercoat (0.025μ thick) causes the intermetallic compound to grow in the form of rounded equi-axed crystals (Figs. 2 and 3). The coverage of the base steel seems virtually complete and accelerated corrosion tests appear to indicate a four-fold improvement in corrosion resistance for the materials prepared with tin-nickel or nickel as compared with tinplate prepared without an undercoat. Both nickel and tin-nickel appear to be particularly potent in their influence on the morphology of FeSn₂.

We thank Dr. W. K. Armitage of Acon Laboratories for the preparation of the electron micrographs.

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