History of Aluminum Anodizing in Japan

Hideaki TAKAHAHI

Nippon Kemi-Con Co. (Emeritus Prof. of Hokkaido Univ.)

1. Introduction

Anodizing is an electrochemical treatment to form oxide films on metal by anodic polarization in electrolytic solutions. Aluminum products are frequently anodized to modify chemical, physical, optical, and electric properties of the surface. Anodic oxide films on aluminum are classified into two groups: a porous type and a barrier type. Contribution of Japanese researchers to the development of sciences and technologies on aluminum anodizing is introduced here.

2. Porous anodic oxide films

Formation of anodic oxide films was initiated in England and Japan ca. 90 years ago. S. Seto and S. Miyata[1] developed an oxalic acid anodizing and pore sealing treatments in boiling pure water and in pressurized water vapor. T. Asada[2] developed electrolytic coloring, in which Sn, Ni, Cu et al. were deposited into pores of oxide films by electrolysis with alternative current. The patent on the electrolytic coloring in 1977 affected much the surface treatment of out-door products, exterior walls, doors, widow frames et al. In 1995, H. Masuda et al.[3] found the formation of highly ordered hexagonal structure in the porous anodic oxide film by a two-step anodizing and by a mold texturing. Application works based on the pore-filling and cell-ordering technologies increases rapidly in this decade. The authors[4] developed micro-technologies by the combination of anodizing with laser irradiation and electrochemical coating.

3. Barrier anodic oxide films

Formation mechanisms of barrier oxide films were initially investigated by A. Güntherschultze & H. Betze[5] in 1931, and high field theories on the oxide film formation have been established by 1956. Using an electron beam-induced crystallization method, K. Shimizu et al.[6] clearly showed the transport of electrolyte anions across the oxide film during anodizing in 1981, and H. Habazaki et al.[7] showed the cation transport in 1995. The transport of anions and cations was related with the bonding energy of metal and oxygen. The authors[4] clarified the formation mechanisms of crystalline oxide films, and developed the formation of Al-(Ta, Nb. Si, Zr) composite oxide films by the combination of anodizing with other coating techniques.

4. Reference

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7) H. Habazaki et al.: Thin Solid Films, 300, 131 (1997).