第15卷 第2,3期 广东有色金属学报 Vol. 15, No. 2,3
2005年9月 JOURNAL OF GUANGDONG NON-FERROUS METALS Sep 2005

Article ID: 1003-7837(2005)02,03-0501-01

Energy flows control in breakdown zones during the coating formation in electrolytes at high potentials

Gordienko P. S., Vasilenko O. S., Dostovalov V. A., Panin E. S., Bulanova S. B.

(Institute of Chemistry, Far East Department, Russian Academy of Sciences, Vladivostoka 690022, Russia)

First published papers on light phenomena on an anode-polarized electrode in electrolyte were written by Russianena on anode-polarized physical chemist N. P. Sluginov who reported his observations in the Journal of Russian Physical Chemical Society in 1880s. In the first half of the 20th century the phenomena of sparkling and anode layer breakdown were studied by A. Güntherschulze, G. Betz, I. Kurchatov etc. while since 1970s the anode-sparkling, micro-arc oxidation (MAO), micro-plasma, ANOF processes have attracted significant interest from scientists in many countries. At present, it is generally accepted that a breakdown of oxide layers is determined by the development of electronic avalanches at the electrolyte/oxide interface that results in the formation current increase in breakdown zones by more than hundred-fold. The temperature increase in the breakdown point up to several thousand degrees induces plasma-chemical processes. The effect of these processes in the breakdown zones is of ambiguous character-both the formation of coatings of complex composition on cathode surface and destruction of coating and/or cathode material are possible.

Although the breakdown phenomenon has been under study more than 100 years, no reasonable suggestion on the possibility of controlling the flow of energy introduced into the breakdown zone has been put forward. We have performed a theoretical analysis of reaction of the whole system (voltage source-anode-oxide-electrolyte-cathode) on the emerging local breakdown zone with non-liner electrophysical parameters. It was shown experimentally that introduction of an additional size-controlled reactive resistance into the system under study enables one to control the rate of energy input into the breakdown zones.

It has been shown for the first time that use of the electromagnetic induction phenomenon in electrolysis processes allows controlling the rate of energy input into local breakdown zones and build coatings in electrolytes with pre-determined electrophysical properties at high potentials. (The report will present data on structure, defects, formation currents, specific electrical resistances of coatings built on titanium and aluminum with limited and unlimited values of energy flows in breakdown zones).

Received date: 2005-09-26