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Optical properties of Al-based binary alloy coatings

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The angular dependences of ellipsometric parameters have been measured for the Al-based coatings obtained under different sputtering conditions and regimes of further processing. The Al–Si and Al–Zn alloy layers were sputtered using electro-spark metallization. In addition, the samples were rolled with relative deformation of 25 % to compact the sputtered layer and mechanically polished using diamond pastes. The surfaces of some samples were compacted by means of abrasive-jet treatment simultaneous with the coating sputtering. It was shown that increase the sputtering gas of pressure and the arc power and diminishing of the distance between the electric arc and the substrate results in an increase of the main incidence angle, changes of refractive index and reflectance of the surface coating layer. The additional compaction of coatings causes an increase of the main angle of incidence and real part of the complex dielectric constant.

Определены эллипсометрические параметры при разных углах падения света для покрытий на основе Al, полученных при разных условиях напыления и режимах дальнейшей обработки. Напыление слоев сплавов Al–Si и Al–Zn осуществлялось методом электродуговой металлизации. Дополнительно образцы были прокатаны с относительной деформацией $\varepsilon = 25$ % для уплотнения слоя покрытия, а потом была проведена их механическая полировка с использованием алмазных паст. Поверхность части образцов уплотняли с помощью струйно-абразивной обработки, проводимой одновременно с напылением покрытий. Установлено, что повышение давления газа, распыляющего диспергированный расплав, мощности и уменьшение расстояния между дугой и основой приводит к увеличению основного угла падения, изменению показателя преломления и коэффициентов отражения поверхностного слоя покрытий. Дополнительное уплотнение покрытий приводит к увеличению основного угла падения и действительной части комплексной диэлектрической проницаемости.

According to the field of application and functional destination, different powders and wires are used for gas-thermal coatings. Among 110 known types of coatings, 7 material types belong to metals, 35 to alloys, 12 to oxides, 6 to high-melting compositions and hard alloys, 21 to composite materials and 29 types belong to mechanical blends [1]. While properties of pure metal coatings of pure metals in their entirety are studied well enough, the list extension of new coating types meeting adequately the ever-increasing requirements of industry, proceeds from the development of new alloys, composite systems and mechanical blends. Researches of last years have shown that gas-thermal coatings of Al–Zn alloys have not only high corrosion resistance but also electrical characteristics providing their effective usage for satellite antenna refractors. Zn substitution for Si notably reduces the product corrosion resistance as compared to Al–Si alloy coatings, but allows wide-ranging variation of the product electrical and optical properties. The ellipsometry method provides a rather complete information on changes in optical properties of specified coatings and allows to estimate the possibility of such property control by changing the coating composition and sputtering procedure. That is why this optical method was used in this work. Another reason