Surface Technology for Optical and Electrical Connectors

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Abstract

This thesis treats surface engineering with the purpose of improved quality of optical and electrical connectors with a focus on electroplated and magnetron sputtered materials. In electroforming of tools for manufacturing optical connectors, the influence of ultrasonic agitation on intrinsic stresses and filling properties of electroplated Ni has been studied. It is established that the ultrasonic agitation at the substrate surface during deposition impacts the intrinsic stresses making it possible to increase deposition rate via current density, with stress-free or low-stress levels in the Ni layers. Reduced variations of the intrinsic stress over the surface with the current density is a further important result. Filling of grooves by electroplating of Ni using ultrasonic agitation is demonstrated. This is due to increasing mass transport of species into the grooves compared to conventional pumped agitation. The enhanced filling properties makes it possible to electroplate Ni in the bottom of high-aspect-ratio grooves. In order to industrially implement new nanocomposite coatings on electronic connectors, studies have been performed regarding the thermal diffusion barrier properties against Cu for Ti-Si-C and Ti-Si-C-Ag nanocomposites, deposited directly onto Cu substrates or with sputtered Ni, Ti or electroplated Ni as an intermediate coating. The application of an electroplated Ni diffusion barrier coating, hinders Cu from reaching the surface of the nanocomposites. Also, Ti-Si-C-Ag nanocomposite deposited on magnetron sputtered Ni or Ti on Cu substrates hinder Cu from diffusing to the surface after annealing. The contact resistance of Ag-Pd topcoated Ti-Si-C-Ag-Pd and Ti-Si-C-Ag nanocomposite coatings in contact with hard gold is shown to compete with hard gold in contact with itself, as electrical contact coatings at contact forces around 5 N. Ag-Pd topcoated Ti-Si-C-Ag-Pd in contact with hard gold is shown to have approximately the same contact resistance as hard gold in contact with hard gold at contact forces around 0.1 N, which here is in the 10 m range, while Ti-Si-C-Ag nanocomposite coatings in contact with hard gold has a contact resistance that is up to 10 times higher. The overall contribution of this thesis can be summarised as a deeper knowledge and understanding of techniques and coatings, that help reduce cost and increase reliability of electronics.