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# Development of an electrodeposition method to enhance the solderability of lead-free solder on nichrome alloy

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Nichrome (Ni/Cr) alloy is used in many industrial applications due to its unique electrical properties and marketability. These alloys consist of passive surfaces due to the chromium oxide layers formed on the nichrome surface. This passive oxide layer forms when exposed to the ambient environment and tends to change the alloy surface's energy. It also decreases the wettability of common soldering materials, which seriously affects the electrical and electronic manufacturing industry, as the low surface wettability leads to poor solderability. Poorly soldered wires can cause problems such as fluctuating resistance and short-circuiting. In this study, a novel passivity breakdown strategy is introduced to enhance the solderability on nichrome. Solderability was assessed by analyzing solder droplets on the nichrome alloy surface. The potential of nickel electroplating was investigated as a method to improve solderability. Simple electroplating will not give a stable nickel layer on the alloy. Therefore, the conditions and pre-treatments required to achieve a stable electroplated layer on the nichrome surface were studied. A nichrome tape with a thickness of 20 μm was used as the cathode electrode. One side of the nichrome tape was electrolytically polished, and a non-conductive polymer was coated on the other side. A nickel metal plate was used as the anode electrode. An acidic bath containing $NiCl_2$ was used to breakdown the passivity of nichrome. Next, a Watt's type bath was used to electrodeposit nickel on the pre-treated nichrome tape. The electroplating parameters such as plating time, pH, and current density of the Watt's bath were investigated, and the effects of these parameters on the quality of soldering were analyzed. An image processing software and contact angle measuring instrument were developed for the solder droplet analysis. The investigation was carried out by droplet shape analysis, and it was done by employing polynomial and ellipse fitting methods. After nickel electroplating, the contact angles of solder droplets were reduced, which in turn improved the solderability. The optimal conditions for obtaining a better solderability are pH of 4.0, current density of 400 $A/m^2$, and plating time of 3 minutes.

**Keywords:** Nichrome, Contact angle, Wettability, Solderability, Nickel electrodeposition