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**Microstructural characterization of Cu-Sn-Zn electrodeposits produced  
potentiostatically from acid baths based on trisodium nitrilotriacetic**

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**Abstract**

This study characterizes the Cu-Sn-Zn electrodeposits produced potentiostatically from baths containing different concentrations of  $\text{Cu}^{2+}$ ,  $\text{Sn}^{2+}$  and  $\text{Zn}^{2+}$  ions and 0.60 M trisodium nitrilotriacetic (NTA) at pH 4.99 (higher stability). Ternary electrodeposits were produced onto AISI 1010 steel substrate at electrodeposition potential of  $-1.60\text{ V}$  with electrodeposition charge density of  $3.0\text{ Ccm}^{-2}$ . Chemical composition of electrodeposits varied significantly, presenting higher Cu content (at%) than that of other elements. Furthermore, it was verified that the high concentration of  $\text{Sn}^{2+}$  ions in the baths hindered the reduction of  $\text{Zn}^{2+}$  ions, leading to Zn-poor electrodeposits. Microstructure was generally composed of irregular crystallites and clusters of crystallites or dendrites dispersed on the surface, depending on chemical composition. X-ray diffraction showed formation of the ternary alloy by mixture of the  $\text{Cu}_5\text{Zn}_8$ ,  $\eta$ - $\text{Cu}_6\text{Sn}_5$  and Sn pure phases. In addition, electrodeposits with lower Cu content (at%) also showed the SnO phase. Surface topography of the electrodeposits presented a rough aspect, with arithmetic roughness varying from  $1.83$  to  $3.90\text{ }\mu\text{m}$  for electrodeposits with lower and higher Sn content (at%), respectively. Adhesion tests

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