Fabrication of nanowires

Effect of deposition potential, pH, deposition temperature and electrolytic cell concentration on formation of cobalt nanowires

Tahir Mehmood, Aiman Mukhtar, Wu kaiming

The State Key Laboratory of Refractories and Metallurgy, Hubei Collaborative Innovation Center for Advanced Steels, International Research Institute for Steel Technology, Wuhan University of Science and Technology, Wuhan 430081, China

E-mail: tahir10621@yahoo.com

To understand the mechanism for formation of fcc-cobalt nanowires in electrodeposition, we have systematically studied the effect of deposition potential, pH, deposition temperature and electrolytic cell concentration on the formation of fcc Co nanowires by X-ray diffraction (XRD), transmission electron microscope (TEM) and scanning electron microscope (SEM). The Co nanowires deposited at the potential of -1.6V are pure hcp phase. When increasing the value of potential to -2.0V, there are hcp Co and fcc Co crystals in the deposited nanowires. The fraction of fcc Co crystals in the nanowires increases with increasing the potential value. At -3.0V, the nanowires are pure fcc Co. The pH of the solution has little effect on formation of fcc Co nanowires. We have also seen that high concentration and low temperature favors fcc phase whereas low concentration and high temperature favors hcp phase. However, at 35^{o}C the co-occurrence of hcp and fcc phases were also observed. These experimental results can be explained by the classical electrochemical nucleation theory. The formation of fcc Co crystals can be attributed to smaller critical clusters formed at a higher potential value since the smaller critical clusters favor formation of fcc nuclei.