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Pulsed electrodeposition of metals into porous anodic alumina and study of obtained metallic nanowires properties

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Recently the interest in the fabrication of one-dimensional nanostructures has been increasing because of their potential use in high-density magnetic memories [1], single-electron devices [2], microwave devices [3], sensors [4], etc. One of the most promising methods to manufacture such structures is template-based growth. Behind the different templates porous alumina is a very advantaging structure as a low-cost material with the wide range of controllable geometrical parameters. However investigation of methods for controllable filling the pores is the most challenging problem nowadays.
A detailed analysis of the optimum regimes of pulsed current metal electrodeposition into pores of porous anodic alumina was performed. Nanowires of Cd, Zn, In, Ni, Co, and Cu were embedded into porous alumina by pulsed electrodeposition technique using an asymmetric rectangular AC signal. Optimal values and durations of the anodic and cathode signal were calculated for all the metals mentioned above. Deposited metal nanowires were characterized by scanning electron microscopy, atomic force microscopy, and X-ray diffractometry. Microwave properties of Ni and Co were determined by electron spin resonance. Saturation magnetic moment in parallel and perpendicular orientation and self-resonant frequency were identified. The influence of geometrical properties of the Zn, Cd and In nanowires on its melting point was defined using differential scanning calorimetry. The nonmonotonous dependence of the melting point on the nanowire diameter was found that could be explained by increasing role of surface effects.

References:

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