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Studies of positron trapping at quantum-dot-like particles on metal surfaces

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Abstract

The decrease of the Fe $M_{2,3}$ VV positron annihilation induced Auger signal intensity and the enhancement of the Cu one with enrichment of the Cu content of the Fe–Cu alloy is explained by theoretical calculations as being due to trapping of positrons in the regions of Cu nanoparticles embedded in the top atomic layers of Fe.

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1. Introduction

The physical and chemical properties of quantum dot structures have been the subject of extensive studies because of the prospects of an ever increasing range of their applications in semiconductor electronics, quantum communications, biological imaging and cell technology [1,2]. Recently Nagai and coworkers [3] have provided clear evidence that positron spectroscopy can be used to characterize the properties of quantum-dot-like nanoparticles embedded in host material even at dilute levels as a result of the preferential trapping of positrons in the nanoparticles. Measurements of the positron annihilation induced Auger electron (PAES) spectra from the Fe–Cu alloy surfaces with quantum-dot-like Cu nanoparticles embedded in Fe reveal a large enhancement of the Auger signal of Cu for surfaces created by enriching the Cu content of the Fe–Cu alloy [4]. In this paper we analyze these experimental results by performing calculations of positron surface states and annihilation characteristics at the Fe(100) surface with quantum-dot-like Cu nanoparticles embedded in the top atomic layers of the host substrate.

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