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MICROSCOPIC AND RESONANT PHOTOEMISSION STUDY OF Si\Gd

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The paper presents study of Gd atoms deposited on Si(111) surface with application of Atomic Force Microscope (AFM) and Fano-type resonant photoemission with application of synchrotron radiation (Flipper II, HASYLAB, Hamburg). The application of synchrotron radiation in the region of energy hv corresponding to the Gd 4*d*-4*f* transition (130 – 170 eV) gave the possibility to measure Fano-type resonant photoemission spectra [1]. The layers of thickness 2, 20, 150 and 3000Å were deposited in UHV conditions. The spectra of Si valence band with contribution of Gd 4*f* and 6*s* electrons were studied *in situ* by resonant photoemission spectroscopy for layer of Gd with 2 Å thick deposited on Si(111) clean surface. The photoemission study gave the curve of the Fano resonance shape with resonance for *hv* = 151.8 eV and antiresonance for *hv* = 146.8 eV. The Gd 4*f* localized electrons gave the contribution to the valence band density of states located at 9.8 eV below the valence band edge. The Gd layers of thickness 20, 150 and 3000 Å were deposited in UHV conditions and the AFM images were taken in the normal atmosphere conditions. The AMF study showed remarkably deep craters created deep in silicon crystal surface region under deposited 150 Å of Gd layer. Creation of the craters can be correlated to the high chemical reactivity of Gd atoms with Si. The Gd atom has configuration Gd $4f^7 5d^1 6s^2$ of the valence electrons and it is the next after Eu with

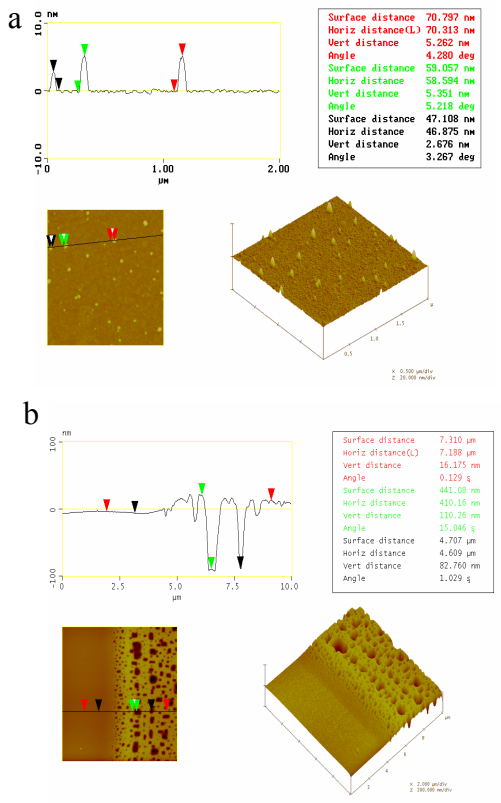

Figure 1. AFM images from Si surface deposited with 20 Å layer of Gd (a) and Si surface deposited with 150 Å layer of Gd (b). In (b) the border of Si-Si/Gd region is presented.

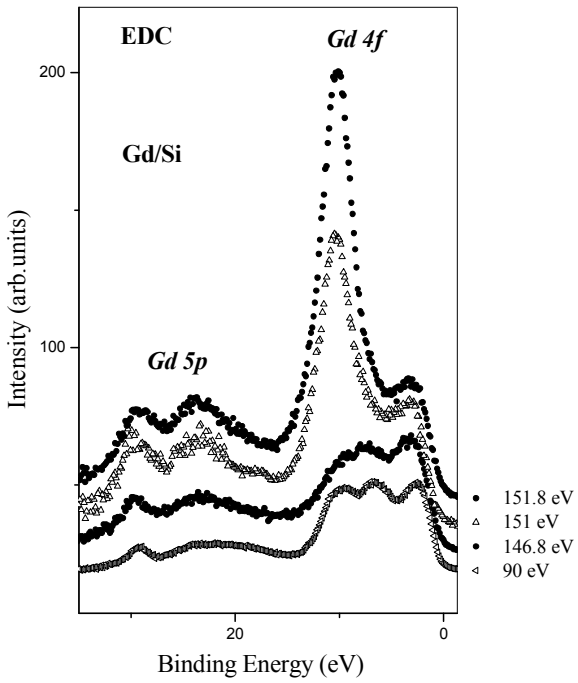

Figure 2. The set of EDCs measured for deposited 2 Å of Gd on Si(111) surface. The binding energy range covers the region of the silicon valence band and Gd 4*f* and 5*p* shells.

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electrons configuration Eu $4f^7 6s^2$. The high reactivity can be caused by lightly bound Gd $5d^1$ electron which frequently contributes to the conduction band of semiconductors and Gd atom is a donor impurity in most semiconductor compounds and appears as Gd^{3+} ion. The reaction of Gd and Si atoms has an explosive character and the dominant diffusion component is silicon [2-4]. It leads to the diffusion of Si into the Gd islands and it is causing the creation of craters in silicon crystal substrate.

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