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Influence of fcc-bcc Structural Transformation on the Physical Properties of Au1-xFex Alloy Films

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Fe-Au alloys are characterized by the complete solubility, and exhibit an fcc-bcc structural transformation at the Fe-rich side. In this study, the influence of the structural *fcc-bcc* transformation on various physical properties of $Au_{1-x}Fe_x$ alloy films was investigated. A set of $Au_{1-x}Fe_x$ alloy films with $0 < x < 1$ have been prepared by rf-sputtering onto glass substrates kept at 293 K (RT). The x-ray diffraction study reveals *fcc* structures for the $Au_{1-x}Fe_x$ alloy films with $x < 0.8$, and *bcc* structures for $x > 0.80$. The equatorial Kerr effect (EKE), optical conductivity (OC) and ε1 spectra for the $Au_{1-x}Fe_x$ alloy films with *fcc* and *bcc* types of structure were studied at RT. It was shown that the EKE spectra for the $Au_{1-x}Fe_x$ alloy films with *bcc* and *fcc* types of structure have noticeably different spectral shapes and magnitudes. Moreover, the magneto-optical (MO) response for the Fe-rich $Au_{1-x}Fe_x$ alloy films with *bcc* type of structure in the UV region of spectra exceeds the MO response for the pure Fe film. The simulation of the EKE spectra, made in the framework of effective-medium approximation, allowed us to conclude that an observed blue shift of the low-energy peak in the EKE spectra of $Au_{1-x}Fe_x$ alloy films, in comparison with the 1.7-eV peak in the EKE spectrum of pure Fe is caused by a difference between the optical constants of alloy and Fe films, while this factor can not explain the enhancement of MO response from the *bcc* $Au_{1-x}Fe_x$ alloys in the UV region of spectra. The OC spectra for the $Au_{1-x}Fe_x$ alloy films with *bcc* type of structure are characterized by an interband absorption peak at 2.0 eV which, probably, has the same nature as the 2.4-eV absorption peak of Fe. This peak is completely absent in the OC spectra of the $Au_{1-x}Fe_x$ alloy films with *fcc* type of structure. It was also shown that the

structural *bcc-fcc* transformation leads to an abrupt growth of the in-plane saturation magnetic field. To understand the magnetic properties of $Au_{1-x}Fe_x$ alloy films more quantitatively, the magnetic circular-dichroism measurement was performed at 2B1 beamline of Pohang Light Source. It was found that the orbital magnetic moment of the constituent Fe atoms in the *fcc* $Au_{1-x}Fe_x$ alloys is larger than that of pure Fe. These results are discussed in connection with the theoretical calculation results.