Verification of Ferromagnetism in Au Nanoparticles with Clean Surface

S. Ishikawa and T. Sato

Department of Applied Physics and Physico-Informatics, Faculty of Science and Technology, Keio University, Hiyoshi, Yokohama 223-8522, Japan

ishikawa@az.appi.keio.ac.jp

Recently, ferromagnetism appearing in Au nanoparticles (NPs) whose surface is not chemically modified was reported. [1] This makes a clear distinction from many studies which have indicated the important role of the surface modification for ferromagnetism of Au [2]. This is because the density of states at the Fermi energy is very low in bulk Au and thus the conventional criterion for ferromagnetism is not suitable to interpret it. In this study, Au NPs are prepared by a physical technique and kept in vacuum after preparation to examine the intrinsic magnetism of samples without O₂ adsorption. As shown in Fig.1, Au NPs of 4nm in average diameter showed ferromagnetism at 300K, and the ferromagnetic behavior intrinsically disappeared in Au bulk which was prepared by heating the nanoparticles without exposure to air. Thus, we reliably verified the intrinsic ferromagnetism peculiar to Au nanoparticles. In addition, we observed the 20% increase in spontaneous magnetization of Au NPs after exposure to the atmosphere (Fig.2). This indicates that the magnetic behavior of Au is modified by electron near the surface of the Au NPs being pulled up by the adsorbed O₂.


Fig.1. Field dependent magnetization of Au NPs and bulk at 300 K.

Fig.2. Change in magnetization of Au NPs after exposure to atmosphere.