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Room Temperature Photo-induced Magnetization of Spinel $(Mn,Zn,Fe)_3O_4$ Thin Films

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The conversion of photonic signal into a magnetic response is of interest both fundamentally and technologically. The spinel ferrites with multiple Fe valences have been identified as a promising class of photomagnetic materials. We report on the observation of photo-induced magnetism in thin films of the spinel $(Mn,Zn,Fe)_3O_4$. These samples were grown via pulsed laser deposition at room temperature to produce cluster-glass like films on Si substrates as well as highly crystalline films on isostructural $MgAl_2O_4$ substrates. Films of $Mn_xZn_yFe_{3-x-y}O_4$ ($0.225 \leq x \leq 0.525$, $0.5 \leq y \leq 0.6$) were studied to probe the Mn-Zn ferrite spinels with a range of anisotropies. Using X-ray magnetic circular dichroism, we have measured the spectra of the Fe $L_{2,3}$ edges to determine the relative distribution of Fe^{2+} and Fe^{3+} on the octahedral and tetrahedral sites. Previous studies have shown that incident light can change Fe from anisotropic Fe^{2+} ($3d^6$) with 4 μ_B/ion to Fe^{3+} ($3d^5$), which is not anisotropic and has an increased magnetization of $5\mu_B$/ion.[1] Using a fiber optic sample holder in a SQUID magnetometer, we have coupled in continuous wave visible light from a 633 nm HeNe laser to the sample. Magnetization vs. temperature measurements both with and without light were performed to determine the extent of the photo-induced magnetization relative to the sample's magnetic field-dependent magnetization. While performing a zero-field cooled magnetization vs. temperature experiment, we have observed a photo-induced increase in magnetization of the cluster-glass samples of 12% at room temperature.

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[1] M. Seki, A.K.M. Akther Hossain, T. Kawai, and H. Tabata, *J. Appl. Phys.* **97** 083541 (2005)