Finally we thank for emeritus professor K.Uematsu of Waseda University, Professor K.Shinagawa of Toho University, Professor T. Fukutomi of Tokyo Institute of Technology and Dr.T.Tamaki of Sci.Eng. Res. Center of NHK for fruitful discussions and warm encouragement. A part of this paper was lectured by K.H. who was invited by Dean Professor T.Hasegawa at Miyazaki University in 1997.

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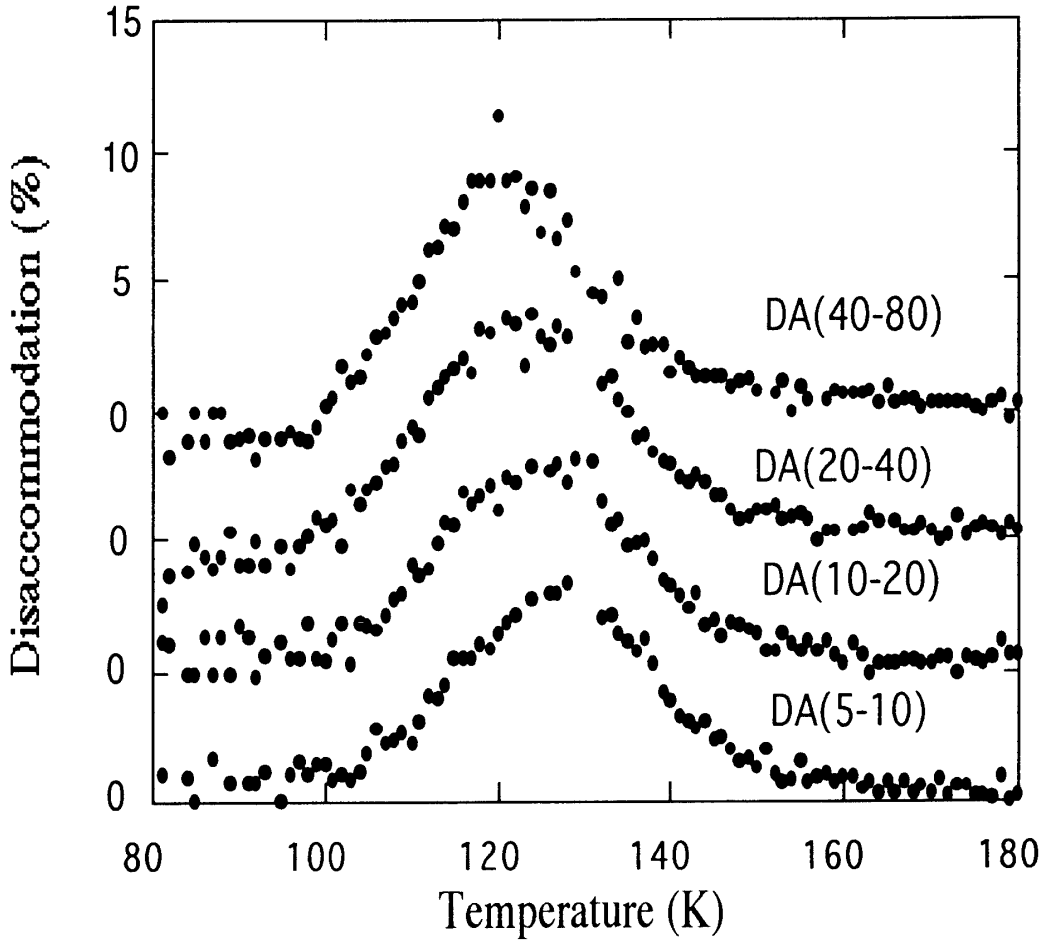


Fig.11 Shift of the DA(1) peaks , depending on the starting time of measurement during DA process .

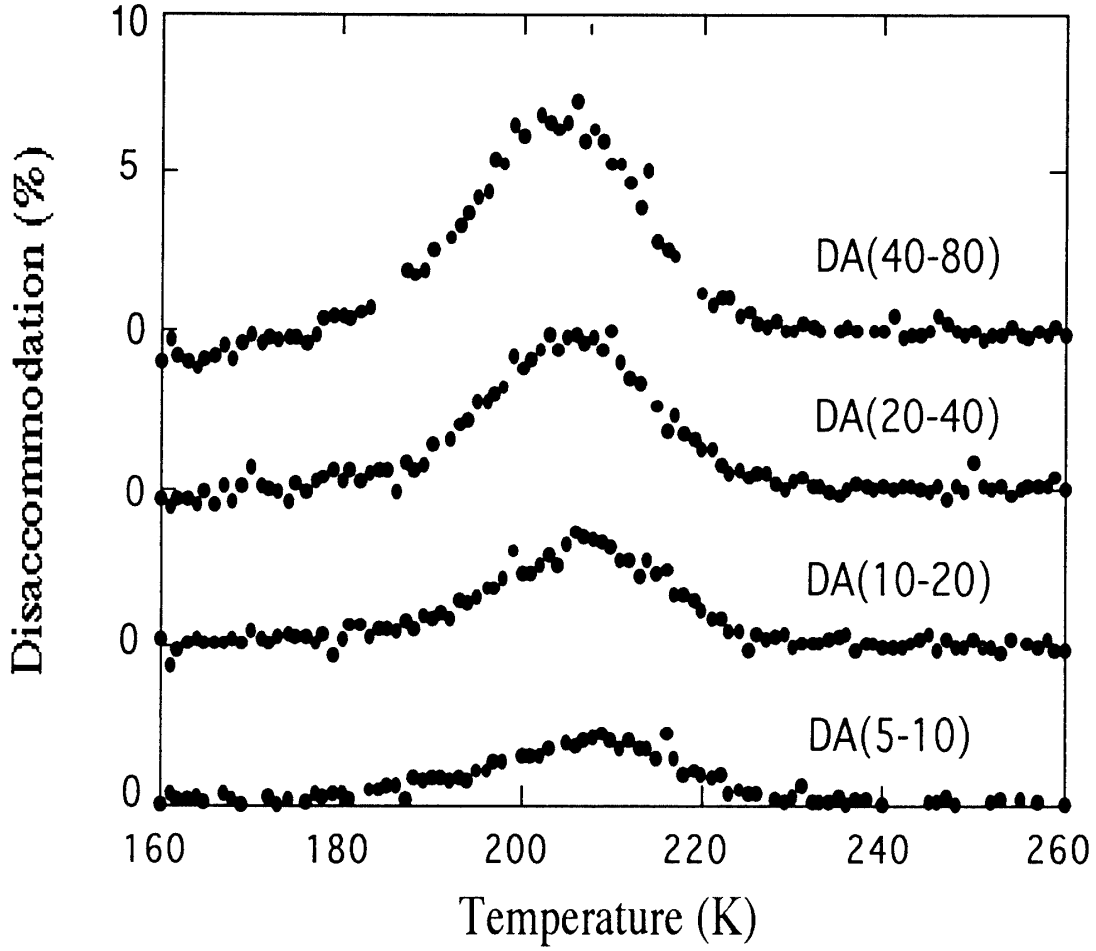


Fig.10 Shift of the DA(2) peaks ,depending on the starting time of measurement during DA process .

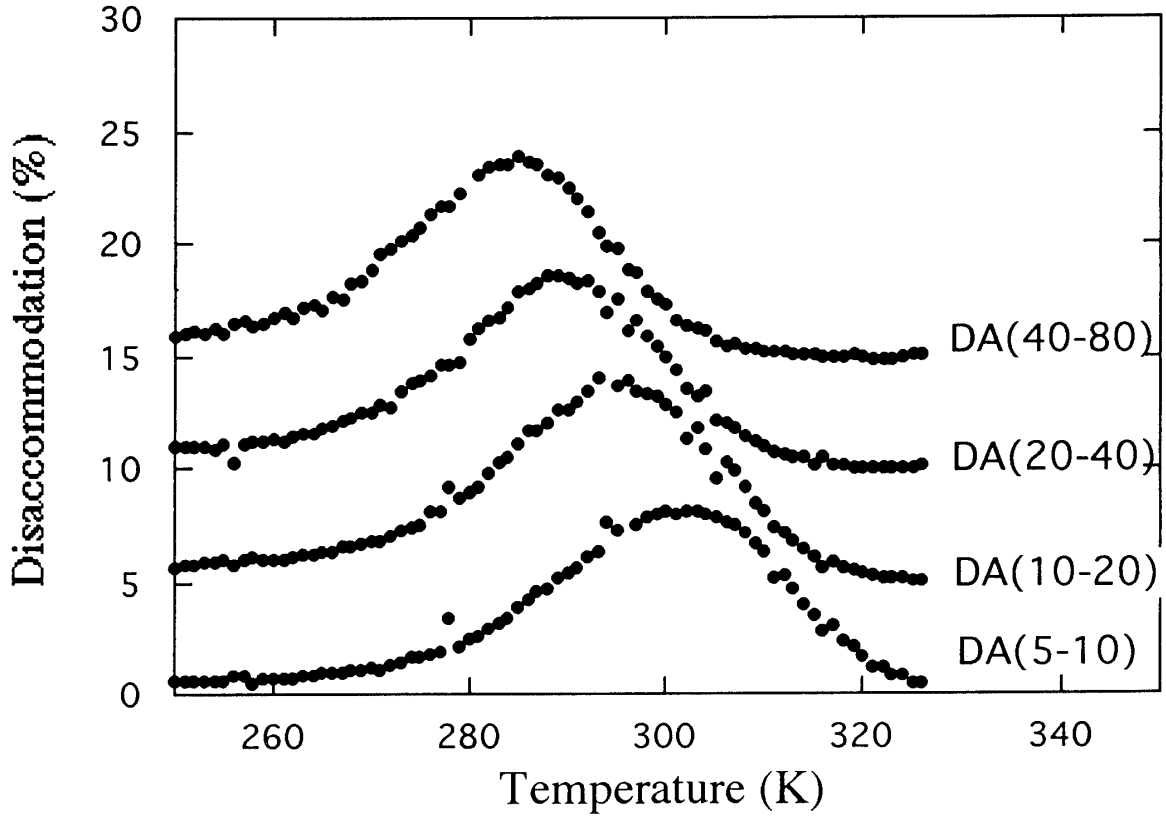


Fig.9 Shift of the DA(3) peaks, depending on the starting time of measurement during DA process .

$$F(n)=U(n)-TS(n)$$
$$=n\Phi - k_B T \ln[(N+n)!/(N!\,n!)]$$

Equilibrium is given by the minimum of the free energy F .
Hence the required n satisfies

$$dF/dn = 0, \text{ i.e.}$$
$$dF/dn = \Phi - k_B T \ln[(N+n)!/(N!\,n!)]$$
$$=0.$$

Then the following result for the vacancy concentration :

$$n / N = \exp(-\Phi/(k_B T))$$

Therefore,vacancy concentration may be estimated if we can get the formation energy in this case. But unfortunately , Φ has not been obtained as far as we know. The binding of the electron to the vacancy is a resultof the net positive charge left by the vacant oxygen atom. The simplest theory of the F - center is the model in which the electron in abox is assumed. This assumes that the electron is completely trapped in the vacant site. The optical absorption of results from the excitation of the electron from the ground state, to excited state orbitals in the box. However, this model for this case is not realistic in the points of the thermal hysteresis of photoinduced DA of YIG[12]. In fact, the electron distribution in alkali halides is not strictly confined to the lattice vacancy means that more realistic models ,sepecially in YIG are required for a proper treatment of the F - center.

Notes added in proof (A)

Very recently (Nobember , 1990), one of he authors (I.Matsubara) observed a shift of the peaks of photoinduced DA in the $\mu - T$ curve, as shown in Figs.9,10 and 11, depnding on the starting time of measurements during the relaxation process or DA , even if the measuring time is constant , in this case, 20 sec. These peaks are clearly shifted to lower temperatures with the starting times. This is very hopeful for simple and determination of activation energy of photoinduced DA. From these data, the activation energy of the peak of DA at the lowest temperature (DA(1)) is obtained approximately 0.46 eV, while the activation energy of DA(2) is 0.6 eV On the other hand, DA(3) is rather acurately determined 0.88 eV , since the back reaction is completed. These seem the reasonable results. The details will be published near future elsewhere.

polaron. We would like to apply this concept to an irreversible photoinduced effect(Enz-type), although the two center model cannot be denied.

Appendix B

An F-center in YIG consists of double electrons trapped at a oxygen vacancy as mentioned in the text.
A vacancy occurs when an oxygen atom in the crystal leaves its normal lattice position. Especially the crystal growth of YIG usually under normal pressure brings into the crystal inevitably oxygen vacancy. The oxygen atom must go somewhere elese. Either the solid will expand a little , the extra atom being accommodated on a normal lattice site. Or it will sit, albeit rather uncomfortably, on an interstitial site.
In the first case the vacancy will usually be formed initially at the surface and is then able to move through the crystal by attomic diffusion. In the second case, both the vacancy and the interstitial defects, once formed , can diffuse through the solid. In fact the existence of vacanciesis the mechanism by which atomic is able to take place, since only one atom has to to move in order for a vacancy and a neighbouring atom to change places. The question is : why do vacancies form, when clearly they require energy to do so? The answer concerns entropy, and the minimizaation of F . F *is* free energy of the system[19].. Certainly U or internal energy must increase when a vacancy is formed. However, at high enough temperature, it is possible for this increase to be more than matched by a decrease in $(-TS)$ giving an oversll lowering of F $(U\text{-}TS)$ .The vacancy (and its interstitial in case 2) are free to be aggregated, eg., M-center in alkali halides and so give a considerable disorder to the crystal.
To be specific, we wish to develop a simplified model of case 1 vacancies. Consider a simple solid of N atoms , which contains n vacancie at temperature T. The problem is to find how n varies with T . Suppose that the formation energy of a vacancy is Φ , and that the vacancies are sufficiently diversed that they are weakly interacting. The increase in U due to the vacancies is then $n\,\Phi$
The solid with n vacancies has $(N+n)$ lattice sites of which N are full and n are empty. Neglecting small surface effects, the number of possible arrangements is

$$(N+n)\,!\,/\,(N\,!\,n\,!)$$

The increase of free energy when n vacancies are present is:

Appendix A

We consider a 180 wall with thickness δ parallel to the xz plane in a uniaxial material having the easy direction of magnetization along the c-axis (z-direction). Furthermore,we assume that the uniaxial anisotropic ions occur on sites with the easy direction either along the x-axis or along the z-axis , and that they occupy a small fraction of these two kinds of other otherwise equivalent sites. Then the energy difference between ions on the two kinds of sites depends on the magnetization direction, which is a function of the position η along the y-axis in the wall, so that a Boltzmann distribution depending on η occus in the the thermal equilibrium state. For a wall displacement during a time small with respect to the relaxation time of ionic diffusion the Boltzmann distribution is unchanged and does not fit in the new wall position. The energy increase ΔE_{anis} per cm^2 wall or pinning energy for a small wall displacement y can be calculated straight - forwardly in the approximation that the turning angle is assumed to increase linearly with the distance in the wall and for a thermal energy kT to be larger than ionic energy . Then, we find the following equation.,

$$\Delta E_{anis}=\frac{\pi\varepsilon^2 ny^2}{4k\delta T}=\frac{1}{2}fy^2$$

where n is the number of hard ions or pinning centers per cm^3 , ε is the ionic anisotropy constant defined by $\varepsilon \sin^2\theta$ for the local , uniaxial anisotropy energy, and f is the stiffness constant arising from pinning . For a large permeability, the above eqn. leads to a permeability decrease :

$$\Delta\mu = \frac{ln\varepsilon^2}{32kT\delta M_s^2}$$

This is derived for thermal equilibrium in the wall and is therefore not rigorously applicable to photoinduced DA. Rough estimation , however, may be applied to this case. On the other hand,let us consider the effect of putting an electron in an unfilled orbital on a particular atom in a solid.The overlap effect will therefore tend to delocalized the electrons and its energy is decreased . On the other hand,the charge will polarize surrounding atoms, which will also lower the energy. In ionic or covalent solids such as YIG ,electrons or holes can also produce more localized distortions, resulting from their electrostatic interaction or

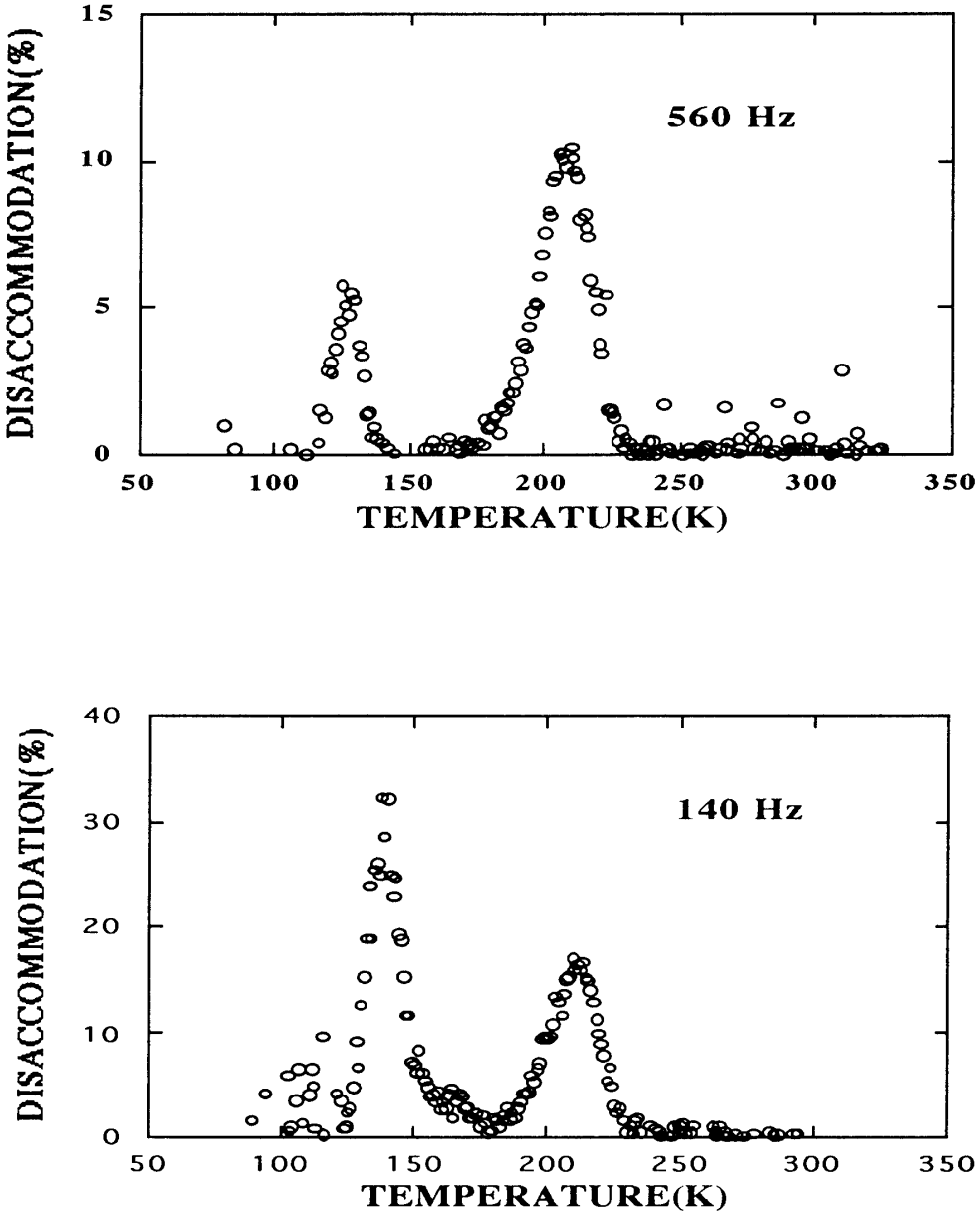


Fig.8 Measuring frequency dependence of photoinduced DA.

model, [2] briefly, the results may be explained:

The rate of photoexcited electron n with time t during illumination is expressed,

$$\frac{dn}{dt} = \alpha(n_0 - n) \qquad (5)$$

Here, n_0 is the trapped electron density, while α is arbitrary constant. By simple carculation, this gives,

$$n = n_0\left(1 - e^{-\alpha t}\right)$$

Contrast to the two center model that n is proportional to the stiffness,[2] we assumed that n is proposrtional to a relaxation time τ, then

$$\tau = \beta\left(1 - e^{-\alpha t}\right) + \tau_0,$$

the above equation is inserted into the general given equation as,

$$\mu'(t) = 1 + \frac{\chi_{rs}}{1 + \omega^2\left\{\beta\left(1 - e^{-\alpha t}\right) + \tau_0\right\}^2} + \gamma' \qquad (6)$$

And also for μ''

$$\mu''(t) = \frac{\chi_{rs}\omega\left\{\beta\left(1 - e^{-\alpha t}\right) + \tau_0\right\}}{1 + \omega^2\left\{\beta\left(1 - e^{-\alpha t}\right) + \tau_0\right\}^2} + \gamma'' \qquad (7)$$

Here, any of γ', γ'', α and β are arbitrary constants. χ_{rs} is an altenating susceptibility constant.

Clearly from eqn.(6), the permeability after illumination decreases remarkably with a measuring frequency . At sight of Fig.8, it is surprising that the peaks of the photoinduced DA depends on the measuring frequency. [17] [18]

It is interesting that the magnitude of $\frac{DA(2)}{DA(1)}$ decreases with the measuring frequency ; approximately 2 at 560 Hz and 1/2 at 140 Hz. Taking into consideration the result shown in Fig. 7, this anomalous behavior could be reasonably understood.

We believe that this simple experiment is applicable also to a study of the dark DA of spinel ferrites . This merit is that free electrons excited by illumination may be controlled finely by photo-exposure time in place of dopants.

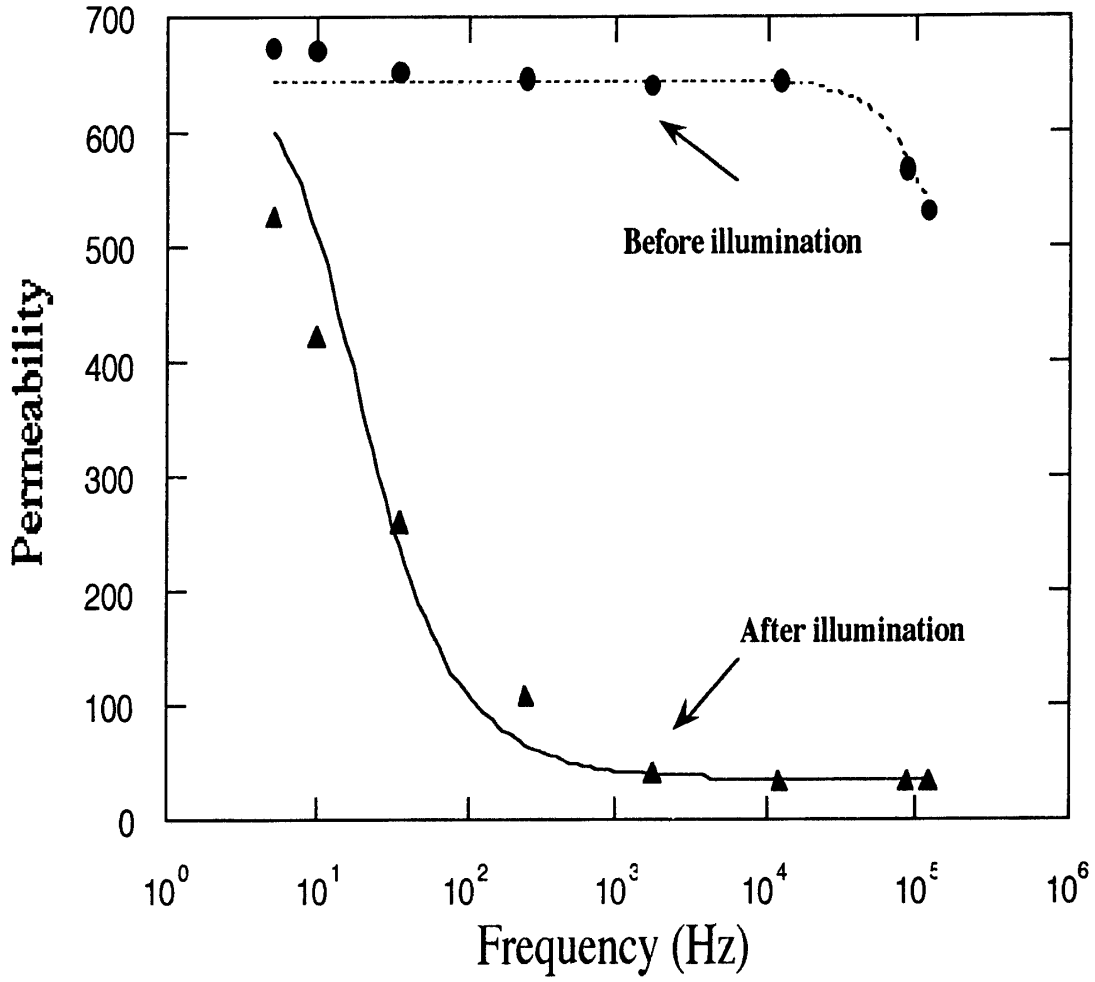
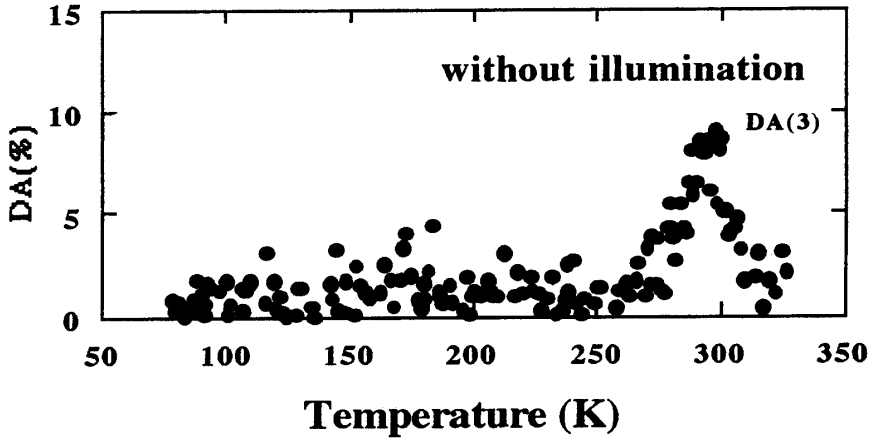


Fig.7 Frequency dependence of permeability at 77 K. (above ;before illumination. Below; after illumination)

displayed in Fig.6 occurs has not completely been understood. So we have proposed a new model [6)7)14)] in the following sentence. As shown in Fig.1-4, one or two concaves in μ-T curves , real or imaginary part, were in the warming process. These concaves are confirmed to be due to DA experimentally and termed DA(1) at lowest temperature of approximately 140 K and DA(2) at higher temperature 210 K . These peaks take place in the illuminated sample. It should be, however, noted that the DA(3) around the room temperature is observed also in as well as unilluminated as illuminated sample, although it could not be always observable, depending on the sample cut from the rods. Warming the sample illuminated at 77 K above 250 K, we observed no influence of the illumination. In preheated sample up to 200 K after illuminated at 77 K, DA(1) disappears, while neither DA(2) nor photoinduced irreversible magnetic effect(Enz-type) is changed. In order for DA to occur , some kinds of carriers such as electrons or vacancy(ion) must rearrange themselves to from an induced anisotropy and stabilize the magnetic domain wall so that the total energy takes minimum. The candidates of the source of DA are Fe^{2+} with photoexcited electron from Vo and the Vo itself .In a previous paper[9)] ,we proposed that the peak of DA at the low temperature could be induced by the short range order of Vo without trapped electrons. A mobility of V_O can be thought in order of value as $V_O{}^i$ (i=0,1e,2e) indicates the number of electrons trapped at the V_O .In this context,it is assumed that DA(1) is due to a time dependent induced anisotropy from a translation of $V_O{}^0$, DA(2) is from $V_O{}^{1e}$ and DA(3) is from $V_O{}^{2e}$. The observation of DA(3) around room temperature may give an indirect evidence of assumption , since DA(3) is independent of illumination. The activation energy [16)] which is now under measurements is so large that the simple electronic process could not account for any DA (1,2,3). Above 250 K , photoexcited electron finds difficulty in returning to the potential well or the oxygen vacancy. Around 200 K, an instability of $V_O{}^0$ may occur so that only DA(1) is vanished . Thus , the coexistence of Enz-type effect and photoinduced DA may be, qualitatively, explained. Furthermore, we measured the frequency dependence of permeability at 77 K before and after illumination. As a result, we found the remarkable dispersion of permeability especially after illumination as shown in Fig.7. This is due to a strong broadening of relaxation time after illumination, e.g., $9.8\ 10^{-7}$ sec before illumination , while $1.3\ 10^{-2}$ sec after illumination.

Based on the modified two-center



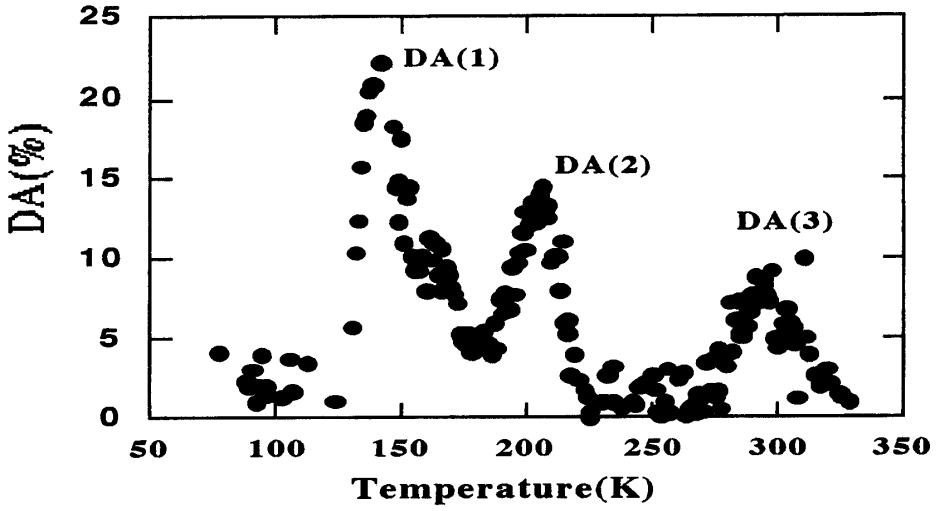


Fig.6 Photoinduced disaccommodation spectrum in YIG single crystal .
(Upper graph; dark DA without illumination, Below graph; photoinduced DA).

uniaxial energy $\delta^2 \Delta E_{anis}(y)$ for

$$\overline{|\Delta N|} = \overline{|N - \overline{N}|} = \sqrt{(n\delta^3/2\pi)} \qquad (2)$$

wall position y of the $N(y)$ anisotropic pinning centers per volume element δ^3 in the wall width respect to the uniaxial energy in a domain must be calculated taking into account the $\sin^4\theta$ term because the $\sin^2\theta$ term used above cancels for equal population of the two types of sites with easy direction along the x-axis and z-axis. Thus we put

easy x-axis;

$$E_x(\theta) = \varepsilon_1 \cos^2\theta + \varepsilon_2 \cos^4\theta$$

easy z-axis;

$$E_x(\theta) = \varepsilon_1 \sin^2\theta + \varepsilon_2 \sin^4\theta$$

where θ is the angle of the magnetization direction with respect to the z-axis(c-axis) for which we use the approximation $\theta = \pi\eta/\delta$ in the wall . Per cm^2 wall we have

$$\delta^2 E_{anis}(\theta) = \int_0^d N(y)/2\delta[Ex(\theta) + Ez(q) - Ex(0) - Ez(0)]d\eta$$

$$= -\frac{1}{8}\varepsilon_2 N(y)$$

Since $y=0$ is an equilibrium position of the wall we have

$$E_{anis}(y) = -\varepsilon_2/8\,\delta^2 [N(0) + \Delta N]$$

$$\frac{\Delta N}{\varepsilon_2 \Delta N_y^2/(8\delta^4)} = \text{const} + \frac{y^2}{\delta^2} \qquad (3)$$

where $|\Delta N| = N(\delta) - N(0)$ is a quantity that will vary along the wall. The mean value of these differences $|\Delta N|$ between the numbers of hard ions in adjacent cubic volume elements will be of the same order of magnitude as the mean deviation $\overline{|\Delta N|}$ given in (2). An approximation that $|\Delta N| = \overline{|\Delta N|}$ and other assumptions (See appendix A) leads to

$$\Delta\mu = \frac{16\pi M_s^2}{lf}$$

$$= 64\pi\sqrt{(2\pi)}\frac{M_s^2}{l|\varepsilon_2|\sqrt{n}}\delta^2\sqrt{\delta} \qquad (4)$$

where $\varepsilon_2 = 9K_1/4\pi$.

Using eqn.(4),we estimated a cubic anisotropy constant of $|K_1| \simeq 50 cm^{-1}$ / ion which is acceptable value for Fe^{2+} or probaly oxygen vacancy .[16]

So far we discussed mainly the photoinduced irreversible or Enz type of decrease of μ' . On the other hand, however, the reason why the photoinduced peaks of DA explicitly

self-trapped exciton in YIG is unclear but probable future problem. The relative positions of the configuration coordinate parabolas is a crucial parameter, leading to either normal or metastable states. Such states are called large lattice relaxation states and are believed to be responsible for a broad class of metastable phenomena observed in many doped semi-conductors. The above discussion is based on the assumption that the strength of defect lattice coupling depends critically on the localization of the electron or hole wave function at the defect. If during any transition this localization changes substantially (e.g. in transition from a localized state to a delocalized defect bound state or in charge transfer involving a localized defect), the lattice around the defects usually undergoes strong rearrangement. The total energy of the system E (electronic and elastic) is plotted versus the local lattice displacement represented by the so-called configuration coordinate Q. [5] A microscopic and quantitative description is quite complicated due to the interference of various interactions among electrons, holes, vacancies and impurities.The microscopic explanation must await detailed analysis of these interactions. Largely overlooked, however, in earlier analysis, we believe the study of these relaxations is helpful for understanding the photomagnetic center in YIG. In order to estimate the potential barrier V_b, the following equation [12] may be introduced ; Here, n is the excited electron surmounting the potential barrier B at the temperature T , n_0 is the excited electrons before illumination, ξ ia the rate of raising temperature of sample, and c is arbitrary constant, From the analysis of experimental results, the value 0.3 eV is obtained. Next we will discuss the photoinduced disaccommodation which we have for the first time observed.[13] In YIG which is a weakly anisotropic material doped with strongly anisotropic ions like Fe^{2+} , [14] domain walls can be pinned by concentration fluctuations of the hard ions or the vacancy of oxygen assumed for the case , pinning centers that are immobile and distributed at random. A semiquantitative equation can be derived using a simple model of the wall. It is obvious that concentration fluctuations in volume that are small or large in size with respect to the wall thickness δ cannot contribute to the pinning process of the wall. This pinning due to concentrtion fluctuations in volume of the order of δ^3 may be estimated by dividing the wall into cubes with an edge δ and or the wall surface into square root of .δ. In a statistical distribution of pinning centers with a mean concentration of n cm^{-3} the mean deviation from the men value of the number of N ions in a volume The

effect . For example the center may

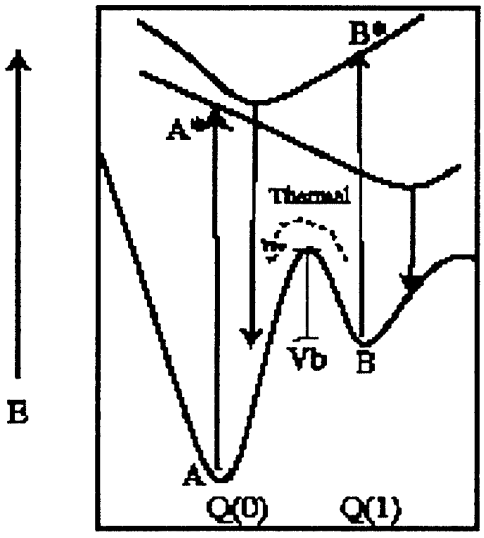


Fig.5 Configuration coordinate diagram. Arrows with the full lines; photoexcited transition or optical back reaction. Arrows with the dotted lines; thermal transition .

consist of a bound ferrous ion-oxygen vacancy complex having four -fold symmetry and exhibiting a local four-fold symmetry. This is similar to i.e., DX center[10] in Al Ga As. The local anisotropies average to zero when the number of occupied centers is the same. Then, if the distribution is made unequal by illumination, the anisotropy is formed. However, it should be noted that our experiment is not for total anisotropy but for domain wall dynamics. At low temperature, oxygen vacancies Vo behave as a type of charge reservoir which consists of two electrons trapped at the sites (Vo ^{2e}) or (Fe^{2+} -Vo- Fe^{2+}) and light sensitive injector of free electrons into this insulating system. That is, the photoexcitation is the alternative method of variation of the free carrier concentration. This process may be illustrated schematically in Fig.5 . These results are interpreted within the context of configuration coordinate(CC) diagrams with large lattice relaxations.[10] In this figure , the point A on the lowest curve corresponds to the total energy in its ground state or (Fe^{2+} -Vo- Fe^{2+}) ; the concave B is (Fe^{2+} -Vo) + Fe^{2+} (nearly free) and the central curve B* is (Vo)+ 2 Fe^{2+} (nearly free) and the upper curve is (Vo) +2Fe^{2+} (free). The direct process begins with electronic excitation by a photon absorbed at Vo^{2e} situated at Q_0 (A—>A*) and then through several paths at Q_1 (B—>B*). The process of the former (A—>A*) needs the much more photon energy than that of the latter (B—>B*). So far the discussion is limited to the situation assumed only for electrons or Fe^{2+} but may be extended for holes or Fe^{4+} . In some materials the transport is strongly inhibited by electron-phonon coupling, namely by forming small polarons or self-trapped states. Here the particles are localized and are essentially immobile. The criterion for the self-trapping has been shown to be *ELR>B*, where *ELR* is the lattice relaxation energy and B is the band transfer energy.[10),11)] The model of the

3. Experimental results and discussion

Figures 1-4 display the results mentioned above, and furthermore , the measurements were continued above. It should be noted in these figures that the concaves of μ-T curves at the first run disappear at the second run so long as each of the turning temperature T_r exceeds above the temperature at which the concave is seen. It is confirmed experimentally that these concaves are due to photoinduced DA[7] as shown in Figs.1~4. In order to explain these results, we correlate an existence of so called F-center with these features. The basic concept of our explanation is as follows. Cooled in the dark, oxygen vacancies or deep donors capture the double electrons and F-centers are formed. Pinning centers for domain walls are created with negligibly small capture rates, when the trapped electrons are photoexcited from the deep levels to the shallow levels or conduction band. Repeated application of the light continue to lower the permeability of the sample measured in the dark until the saturation is attained. Roughly speaking, this occurs after total illumination of about 60 sec at intensity of 10^{-4} Wcm^{-2}. The saturation is approached approximately exponentially with an exponent proportional to the productof the light intensity and total illumination time. The photoinduced decreased perme-ability in YIG returns to the state prior to irradiation,when the sample is brought back to room temperature.[2] The irreversible characteristics may be explained by the assumption that these microscopic barriers around oxygen vacancy prevent the photoexcited electrons from being recaptured, the probable origin of which is the relaxation of the crystal lattice .[10] The irreversible variation in these phenomena is destroyed at room temperature, which is caused by he returning of electrons surmounting the potential barrier V_b to the original state. In several samples, an additional DA peak independent of irradiation is observed around room temperature, the reason of which may be ascribed to oxygen vacancy with double electrons. One of the most interesting characteristics of these phenomena is the appearance of metastability in its properties at lowtemperatures,T<250 K. This metastability of properties may beaconsequence of metastability of atomicconfiguration of garnet system inevitably involving of oxygen vacancy Vo or impurity . The microscopic origin of the photoinduced magnetic effect as yet remains unknown,although the start of the photoinduced magnetic effect began before 30 years. However, it appears likely that some kinds of localized center is responsible for the

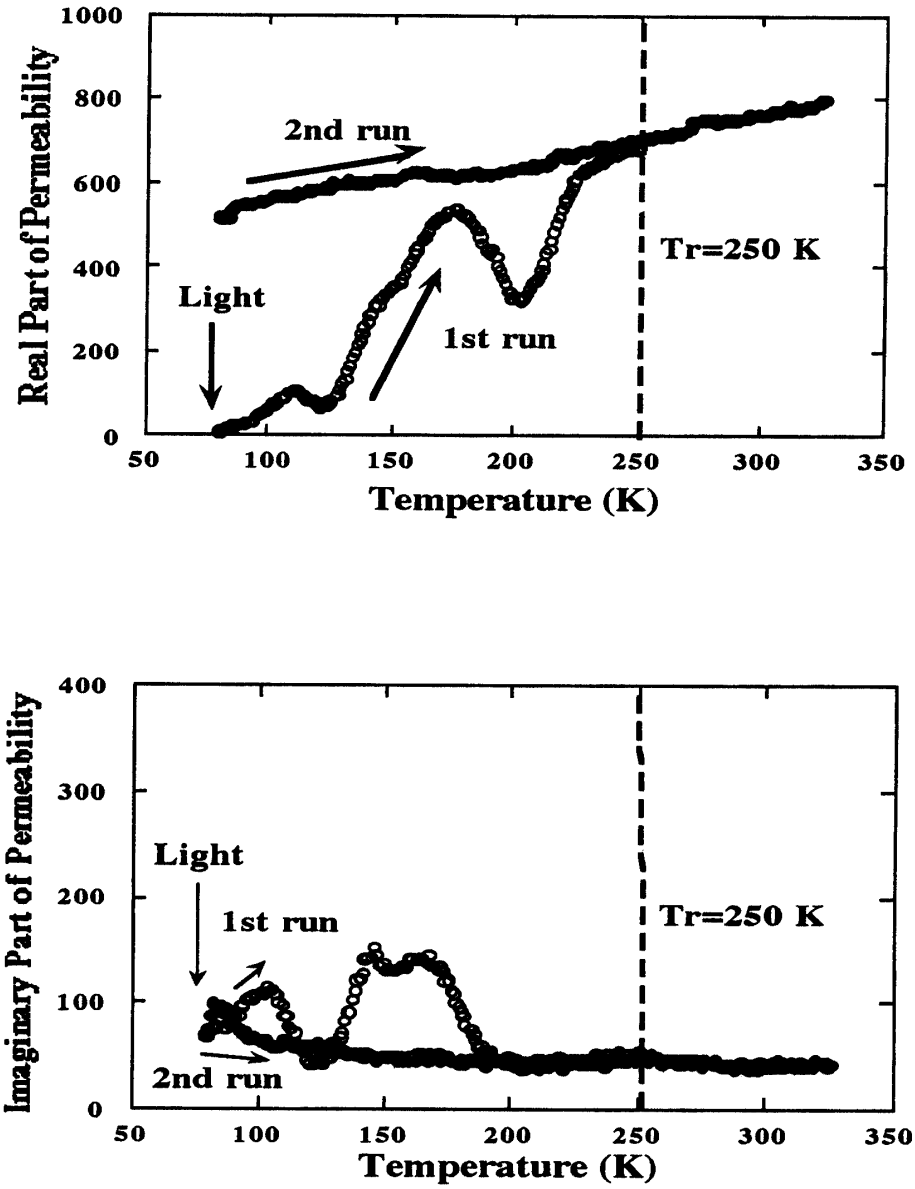


Fig.4 Temperature dependence of complex permeabilities μ' (upper graph) and μ'' (below) of the sam-ples after light irradiation(1st run and 2nd run).
Measuring frequency and field ; 0.14 kHz and 1 mOe, raising temperature rate ; 0.5K/min.Turning temperature ; Tr=250 K. Here, Open circle;1st run, Closed circle;the 2nd run.

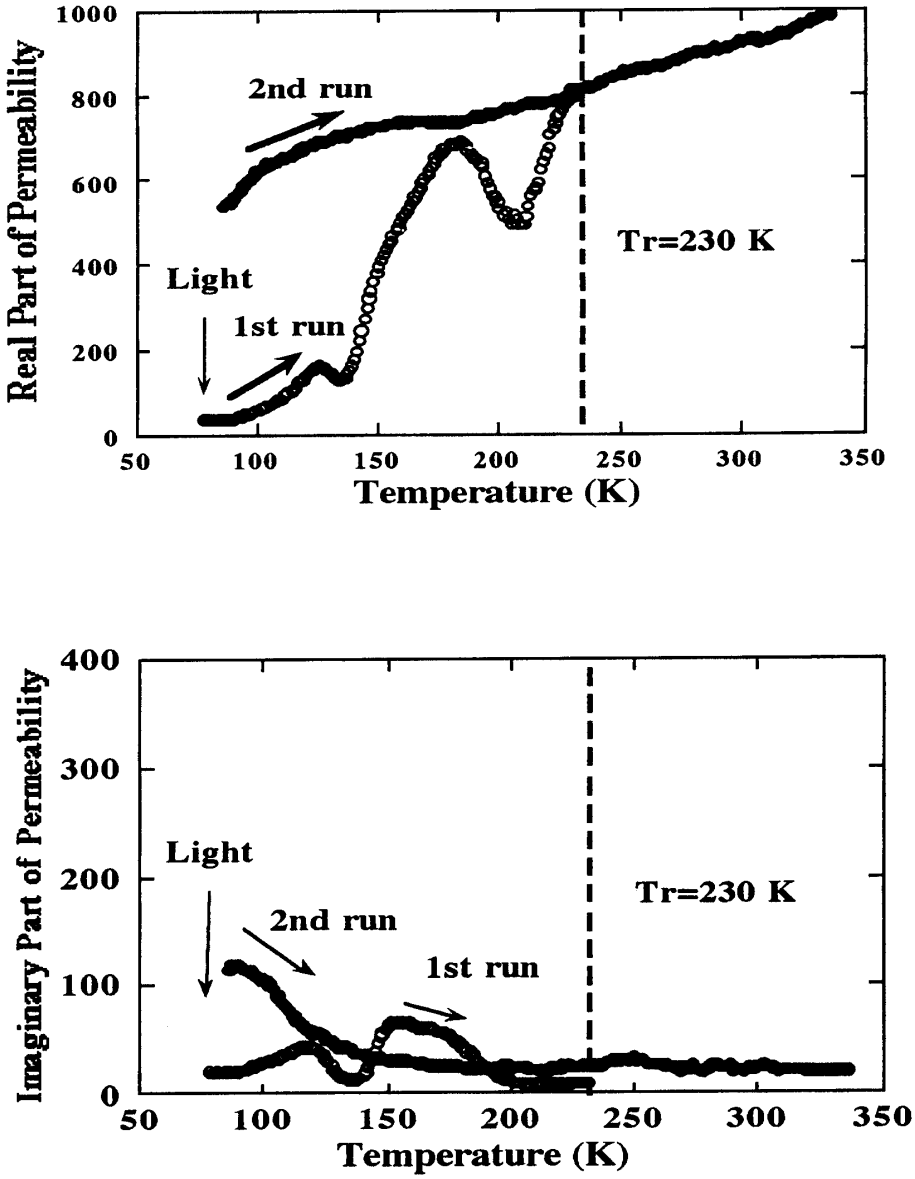


Fig.3 Temperature dependence of complex permeabilities μ' (upper graph) and μ'' (below) of the samples after light irradiation(1st run and 2nd run) .
Measuring frequency and field ; 0.14 kHz and 1 mOe, raising temperature rate ; 0.5K/min.Turning temperature ; Tr=230 K. Here, Open circle;1st run, Closed circle;the 2nd run.

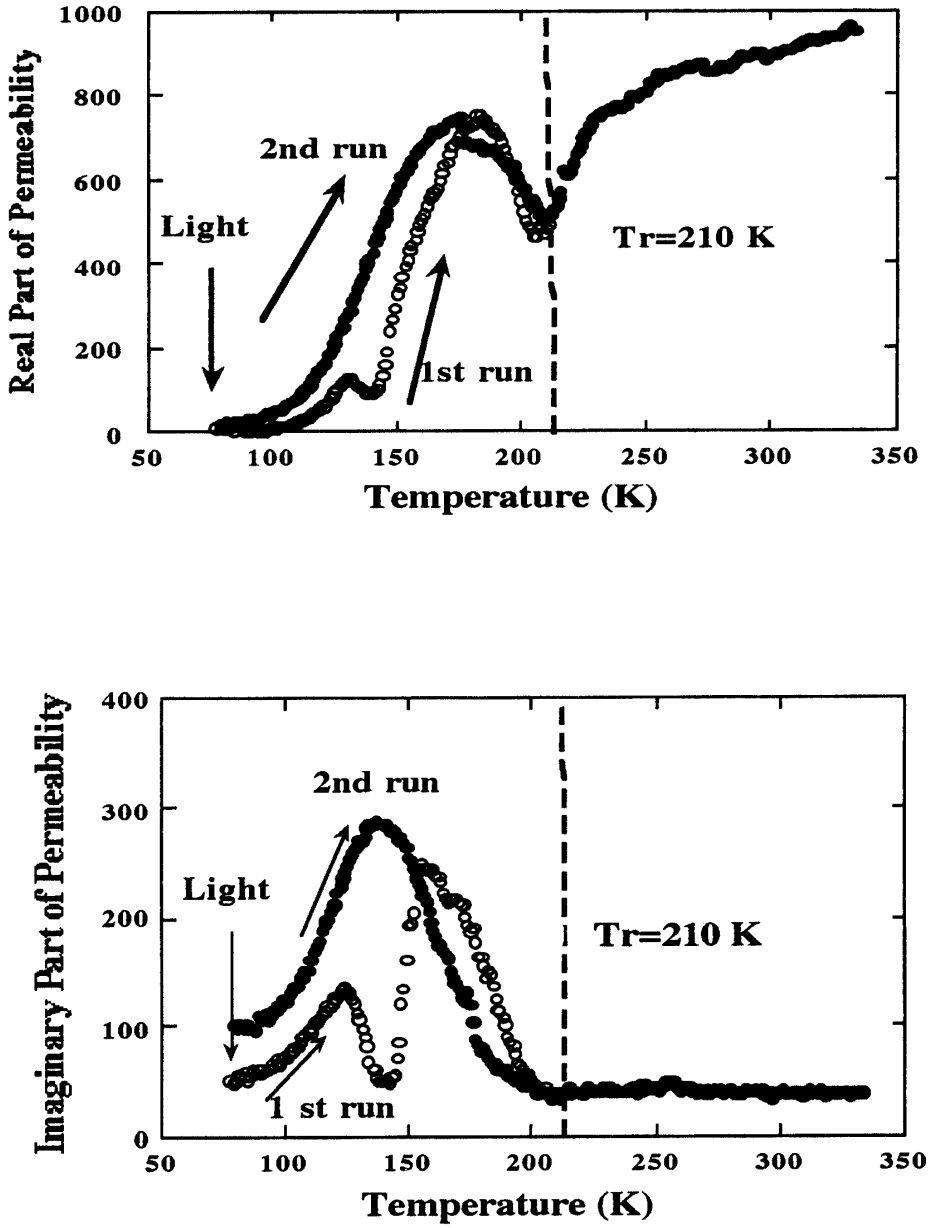


Fig.2 Temperature dependence of complex permeabilities μ' (upper graph) and μ'' (below) of the samples after light irradiation(1st run and 2nd run) . Measuring frequency and field ; 0.14 kHz and 1 mOe, raising temperature rate ; 0.5K/min.Turning temperature ; Tr=210 K. Here, Open circle;1st run, Closed circle;the 2nd run.

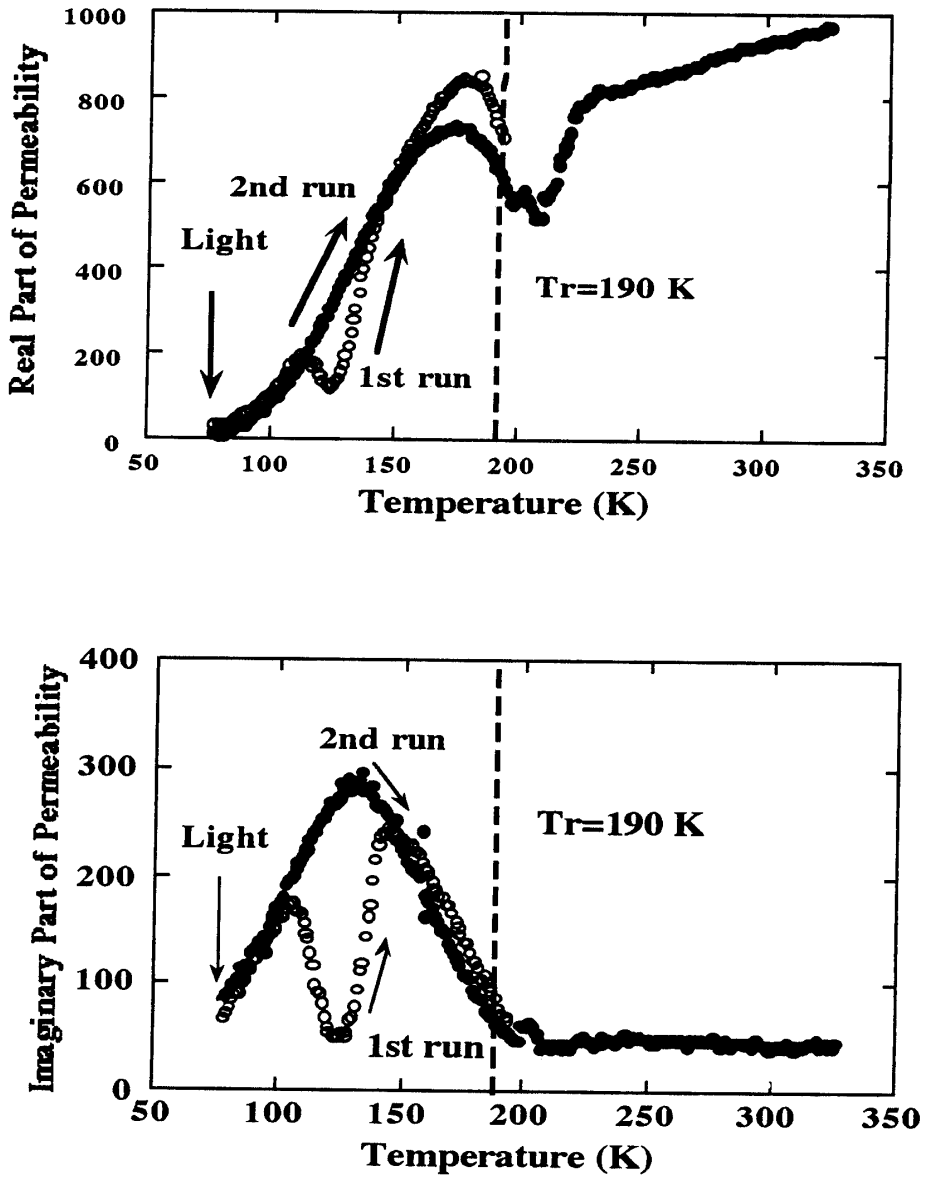


Fig.1

Temperature dependence of complex permeabilities μ' (upper graph) and μ'' (below) of the samples after light irradiation(1st run and 2nd run) . Measuring frequency and field ; 0.14 kHz and 1 mOe, raising temperature rate ; 0.5K/min.Turning temperature ; Tr=190 K. Here, Open circle;1st run, Closed circle;the 2nd run.

oxygen vacancies Vo behave as a type of charge reservoir which consists of two electrons trapped at the sites and light sensitive injector of free electrons into this insulating system. In this report, we observed a thermal hysteresis and the phenomenon of DA can be produced by light irradiation in the high purity crystals of YIG, [4] indicating of photoinduced formation and relax-ation of a potential barrier for photoexcited electron to return to an original state. In our earlier study[See Appendix B], we proposed a model for photoinduced anisotropy.It is well known that insulating crystals such as YIG subject to the irradiation of photons with energy above the ionization gap often exhibit irreversible isomeric trans-formations of the local structure.[5] The excess energy once stored in the crystal by the photoabsorption is released through the emission of enormous number of phonons which give rise to the isomeric reactions, which is expected to show an associated change of μ-T curve. Therefore, the measurement of the temperature dependence of complex permeabilities μ' and μ'' of the samples after irradiation at 77 K was measured, in order to clear the underlying microscopic mechanism of photoinduced magnetic effect,i.e., photoinduced DA we observed recently in YIG. [6]

2. Experimental

These samples of YIG are very pure, with neither Si nor Ca incorporated except for intentional dopants (Ga 0.0625 mol or Ca 0.001mol). In all samples, however, a considerable oxygen vacancy is incorporated of the order of 0.1 mol % estimated from spectroscopic method.[7] Source of irradiating the samples was a xenon lamp, since no conspicuous differences among the many kinds of light sources such as laser light, mercury light , X-ray[8] and or gamma-ray[9] employed in these experiments. The measurement of photo-induced and or usual DA in the dark was carried out using an automated equipment made in our laboratory[10] which allows one to measure the time dependence of the initial permeability, $\mu'(t, T)$, at various temperatures T with any arbitrary time intervals $\Delta t(t_2 - t_1)$ after demagnetization. The experimental results could be represented as an isothermal or isochronical relaxation curves of the magnitude of $\Delta R/\mu(t_1, T)$, where $\Delta R = \mu(t_1, T) - \mu(t_2, T)$. Here, t_1=5 sec and t_2 =50 sec[7] . In order to examine the behavior of μ-T curve after irradiation , the mea-surement was performed continuously, while the warming process at the rate of 0.5~1.0 K/min was stopped at several temperatures termed as turning temperature T r, from the temperature to 77 K cooled rapidly and maintained approximately 10 min. And then again from 77 K, the temperature of sample was raised without irradiation with warming the sample at the same rate in the 1st run.That is the 2nd run.

PHOTOINDUCED IRREVERSIBLE EFFECTS ON MAGNETIC PROPERTIES AND ALLIED PHENOMENA IN MAGNETIC OXIDES IX

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Abstract- In single crystals of yttrium iron garnet irradiated with laser (the most effective wavelength is 700 nm) or white light at 77 K, a remarkable change of the temperature dependence of complex permeabilities μ' and μ'' is observed, which is peculiar to photoinduced magnetic effect. Simultaneously,conspicuous double peaks of DA around 125 K and 200 K below room temperature were found to be induced by light-irradiation, with correlative onset of the irreversible decrease of permeability insensitive to demagnetization at low temperature. The height of potential barrier around oxygen vacancy may be estimated 0.3 eV. In order to explain these observations, we propose that oxygen defects provide a mechanism for occurrence of photomagnetic effects and discuss its validity; the review of these area of our laboratory in 1996 is given .

Keywords: PHOTOINDUCED, DISACCOMMODATION, OXYGEN DEFECTS, LATTICE RELAXATION,YIG

1. Introduction

Photoinduced magnetic effects in Si-doped yttrium iron garnet (YIG:Si) has attracted the attention of researchers since Teal et al. [1] found for the first time one of these effects, so called the I-effect. These effects can be divided into the I-effect (vectorial) and the II-effect (scalar) depending on whether is dominant or not the polarization state of light for the observation. The origin of I-effect was explained as a redistribution of uniaxial anisotropy of Fe^{2+} along one of the four cubic directions of octahedral sites, while the II-effect (Enz-type) was attributed the different behaviors of Fe^{2+} close to and far from Si^{4+} ions.[2] On the other hand, disaccommodation (DA, a gradual decrease of initial permeability with time after demagnetization) which is often observed is, phenomenologically, similar to the II-effect .[3] DA is, however, so far considered as essentially different from the II-effect, since the former is sensitive but the latter is insensitive to photoexcitation and demagnetization. [see appendix A] At low temperature,