Session 25CP

Noise Effect on Resonant Tunneling in the Nanoscale Molecular Magnet (Fe8) 25CP1

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Since nanoscale molecular magnets (Mn_{12}, Fe_8, V_{15}) were reported to exhibit unprecedented features, much effort has been exerted to the quantum tunneling of magnetization. The tunneling dynamics has been studied from a viewpoint of the nonadiabatic transition. The transition probability in the two level system is given by the Landau-Zener-Stückelberg (LZS) formula. This formula is useful to pure quantum dynamics. However, in real systems fluctuation and dissipation affect the process of quantum dynamics. At low enough temperatures, effects of the ubiquitous hyperfine field within the molecule and the dipole field of other molecules become significant for the relaxation process. We study a realistic model with $S = 10$ for Fe_8 and discuss noise effect of the quantum resonant tunneling.

Observation of an unusual equilibrium in the molecular nanomagnet Fe_8 25CP2

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Low temperature susceptibility and magnetic relaxation measurements show a new kind of equilibrium phase in the spin S = 10 molecular nanomagnetic Fe_8. A plateau in the susceptibility results from a competition between the ordering of spins governed by thermodynamics and quantum tunneling of the spins which tends to disorder the system. Very unusual dynamic behavior is observed along the plateau, and the giant spins do not freeze even at very low temperature due to tunneling. As a result the entropy remains extremely large.

25CP3 Nonexponential Magnetization Relaxation in a Manganese Single-Molecule Magnet

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The magnetization relaxation in a tetranuclear manganese cluster Mn_4(pdmH) has been investigated with SQUID and Faraday magnetometer at 0.1 - 0.9 K. The relaxation curves in the tunneling regime show the "square-root time" dependence for a short time after magnetization reversal. This fact suggests the inter-cluster dipole interaction plays an important role for the relaxation.

25CP4 Magnetic Properties of Nanographite Disks Having Edge States

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We study the magnetic properties of nanographite disks, i.e., disk-shaped single-layer graphite fragments on a nanometer scale. The edge states stemming from the zigzag edges make a sharp peak in the density of states at the Fermi energy. The edge states lead to a Pauli spin susceptibility with a Curie-like temperature dependence. The paramagnetic contribution of the edge states competes with the diamagnetic orbital behavior. We discuss the magnetic susceptibility of nanographite disks in relation to that of nanographite ribbons which are diamagnetic (paramagnetic) at high (low) temperatures.

25CP5 Nuclear magnetic relaxation of ^{1}H in molecular cluster magnet V_{15}

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The temperature dependence of the nuclear spin lattice relaxation time T_1 of ^{1}H in S=1/2 molecular cluster magnet V_{15} has been measured below 3.5 T, including the critical field H_C=2.9 T where the ground state of the cluster spin changes from S_z=$-$1/2 for S=1/2 to S_z=$-$3/2 for higher level of S=3/2. The relaxation rate $1/T_1$, which decreases with decreasing temperature, are well interpreted in terms of fluctuating field associated with thermal excitation of the cluster spin. Around the very low field near the level crossing at H=0 for S=1/2, and around 2.9 T, $1/T_1$ becomes much less temperature dependent, which suggests the presence of another relaxation mechanism associated with the level crossing.

Unusual Magnetization Reversal of Mn12 Culster in Ultra-fast Sweeping Fields **25CP7**

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A magnetization reversal of Mn12 Culster has been studied in ultra-fast sweeping magnetic fields. Below 3 K, a jump of magnetization is found in magnetization process in pulsed fields. A temperature dependence of magnetization saturates below the bloking temperature of 1.3 K. Time and critical field of the reversal show a strong sweep velocity dependence. In the ultra-fast limit, the reversal time shows a tedency of a saturation. A simaltaneous revesal of magnetizations is found in two Mn12 molecule sites in which the directions of the easy axes are nearly orthogonal each other. This behavior indicates a finite coupling between the nearest-neighbor molecules. A strong influence of transverse fields is also found.

Linewidth of Single Photon Absorptions in Mn_{12}-acetate **25CP8**

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Quantum mechanical tunneling of the magnetic moment can be observed in several single molecule magnets, including Mn_{12}-acetate, but the tunneling mechanism is not entirely understood. It is likely that tunneling is related to defects in the crystal structure. These defects can be studied through their effect on the inhomogeneous linewidth of single photon (intrawell) transitions. However, most previous studies of the linewidth have been performed on crystals that have been pressed into pellets, which may introduce additional defects into the crystal structure. We report on measurements of the linewidth on loose crystals using the method of time-domain terahertz spectroscopy.

Magnetic Properties of the Noble Metal Nanoparticles Protected by Polymer **25CP10**

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Noble metal (Pd, Pt and Au) nanoparticles protected by poly-N-vinyl-2-pyrrolidone (PVP) samples were synthesized by the reduction of the colloidal solution of metal salts in the presence of the polymer PVP. Their magnetizations as a function of the diameter (2.3 - 3.8 nm) were investigated systematically using SQUID magnetometer. The observed magnetization curves clearly obey the classical superparamagnetic process contrary to the bulk magnetism. These results imply an occurrence of the ferromagnetic polarization in nanoparticles, although one might attribute it to the spin polarization of the surface on these nanoparticles. We also carried out the ESR and μ^+SR measurements on Au nanoparticles with various protective polymer. The role of the surface on the magnetic polarization will be discussed.

25CP11 Transitions of magnetic orders and Kondo behavior in Ce_3Al_{11}

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The coexistence of a ferromagnetic order and an antiferromagnetic order in Ce_3Al_{11} with T_c=6.2K and T_N=3.2K respectively was reported earlier. Through the specific heat measurements on a various sizes of Ce_3Al_{11} nanoparticles, we investigated how these magnetic orders are influenced by the size effect. For 1000 $\mathring{A}$- Ce_3Al_{11} the ferromagnetic order continues to exist but with no emergence of the antiferromagnetic order at lower temperatures. As the size of specimen further decreases to about 100 $\mathring{A}$, no any form of magnetic order is observed as temperature down to 0.5K, instead a low-temperature Kondo anomaly is exhibited. The evolutions of magnetic order disappearance and the enhancement of Kondo interactions are described and a possible scenario is given to illustrate the experimental data.

25CP12 Size effect on magnetic orderings in Ce_3Al_{11}

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Ce_3Al_{11} having an orthorhombic La_3Al_{11} structure has a ferromagnetic transition at T_c=6.2K followed by an antiferromagnetic order at T_N=3.2K. These transitions are associated with the two different sites of Ce_I and Ce_{II}. Ce_3Al_{11} nanoparticles with average particle size about 1000Åwere fabricated and studied by dc and ac magnetic susceptibility measurements. No antiferromagnetic order was observed, whereas the existence of ferromagnetic order is verified by the characteristic behavior of superparamagnetism between 3.3-6.2K. The smaller value of Curie constant of 1000 Å- Ce_3Al_{11} compared with the bulk may be associated with the disappearance of antiferromagnetic order.

25CP14 Observation of avalanche effect of the spin reversal in $Mn_{12}Ac$ by ^{55}Mn NMR

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By using ^{55}Mn NMR, the avalanche effcet of the magnetization of the cluster was observed in single crystal of $Mn_{12}Ac$ between 0.1K and 1.6K in the field range from 0.7T to 1.5T, after reversing the applied field. These results are consistent with the result of the measurement of hysteresis curve of the magnetization. Considering that the strong NMR signal is always observed instantaneuosly, it seems that there is no appreciable change in the temperature of the sample during the reversal.

Superparamagnetic Behavior of $La_{1-x}Sr_xMnO_3$ Nanoparticles in the MCM-41 Molecular Sieve **25CP16**

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$La_xSr_{1-x}MnO_3$ nanoparticles dispersed in an amorphous silicate were prepared by calcinations of molecular sieve soaked in precursor solution. Magnetic properties have been investigated by the susceptibility and magnetization measurements. Superparamagnetic behavior of the nanoparticles is observed both for the antiferromagnetic phase (x<0.1) and for the ferromagnetic phase (x>0.1) at low temperatures. For the ferromagnetic phase, the superparamagnetic moment corresponds to the moment of the single-domain ferromagnetic particles, while for the antiferromagnetic phase, it corresponds to the noncompensated moment of two sublattice in the antiferromagnetic particles.

A Hysteresis Phenomenon in NMR Spectra of Molecular Nanomagnets Fe8: a Resonant Quantum Tunneling System **25CP17**

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A molecular nanomagnet Fe8 with total spin $S = 10$ attracts much attention as a substance which exhibits the quantum tunneling of magnetization below 400 mK. We performed ^{1}H NMR measurements for a single crystal of Fe8 in temperature range between 20 and 800 mK, to investigate quantum states at low temperatures. It was revealed that spectra below 400 mK strongly depend on the sequence of the applied field and those in positive and negative fields are not symmetric, while they are symmetric above 400 mK. We discuss the origin of this hysteresis phenomenon against magnetic field, relating to the initial spin state of Fe8 molecules, resonant quantum tunneling at energy level crossing fields between different eigenstates of $S = 10$ and ^{1}H nuclear spin relaxation process.

Theoretical T_1 Calculation for Isotropic High Spin Molecules **25CP18**

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We calculate the molecular-spin (S), temperature (T), and field (H) dependence of $1/T_1$ for a local magnetic probe coupled to an isotropic high spin molecule, based on spin-phonon interaction. We compare the calculation to recent NMR and μSR experiments in $CrCu_6$ ($S = 9/2$), $CrNi_6$ ($S = 15/2$) and $CrMn_6$ ($S = 27/2$). Although we can account for the high and intermediate temperature regimes, the calculation is fundamentally different from the data at $T \to 0$. Since $1/T_1$ must be due to coupling of the molecular spin to an external heat bath, and since phonon contribution is ruled out at low T, we conclude that at these temperatures hyperfine interactions must play an important role in the molecular spin dynamic.

25CP19 Magnetic properties of NiO nanoparticles

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NiO nanoparticles were produced by annealing $Ni(OH)_2$ monolayer-nanoclusters above 973 K in air. Their diameters were estimated between 2 and 38 nm from X-ray diffraction patterns. In the magnetization measurements superparamagnetic or ferromagnetic behaviors were observed and characteristic properties of NiO nanoparticles were confirmed.

25CP20 Reexamination of Macroscopic Quantum Tunneling Observed in Ferritin

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We reexamine anomalous magnetic relaxations observed in ferritin in the Kelvin regime, the presence of which has been regarded as evidence suggesting the existence of macroscopic quantum tunneling of magnetic moment in antiferromagnetic nanoparticles. In this study, relaxation curves from well-defined initial states were analyzed in detail. It was found that the relaxation slows down when the system is cooled down. On the other hand, it is accelerated by the application of field. These results are quantitatively consistent with the predictions for classical superparamagnetic fluctuations. In other words, the results are not anomalous.

25CP21 Cusp singularities in the magnetization curve of quantum spin systems

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We present a detailed study of the magnetization cusp of the frustrated Kondo necklace model and $S = 1/2$ bond-alternating two-leg ladder by means of analytical and numerical techniques. Using a fermionic bond-operator formalism, we propose that the appearance of the cusps is understood in terms of structure of the energy dispersion. We also discuss the critical behavior of the magnetization near the cusp singularities. We confirm this theory by DMRG calculations.

A New Mean Field Theory for Ising Spin-Fermion Model: Application to Diluted Magnetic Semiconductors

25CP24

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We have investigated the ferromagnetic transition of an Ising spin-fermion model, where Ising spins are located randomly and tight-binding fermions interact with the Ising spins via the exchange interaction. We extended the inhomogeneous mean field theory to include the local dynamics of fermions and applied to this model. We found the ferromagnetic transition occurs only when the density of fermions is lower than that of the localized spins. Also the ferromagnetic moment is not saturated because of localization of fermions due to the randomness. This result is consistent with the CPA calculation.[1]

[1] M. Yagi *et al*, J. Luminescence **94**, 523 (2001)

On the origin of Zener-exchange for Mn-doped III-V semiconductors

25CP25

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Recently, the high-T_C ferromagnetism was found in p-type III-V:Mn semiconductors. The presented microscopic model explains the origin of deep and shallow levels induced by Mn and derives the exchange interaction in the framework of the generic two-impurity Hamiltonian. The impurities perturb the electronic spectrum of the host and generate resonances and localized magnetic moments. An indirect exchange between these moments arises as a result of interference between the local perturbations and bears close similarity to the Zener exchange. The calculated Curie temperatures for Ga-V:Mn (V=As, P, N) are in agreement with experiment.

Low temperature magnetization of $\mathrm{Pb_{1-x}Ce_xTe}$

25CP26

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The magnetization of two $\mathrm{Pb_{1-x}Ce_xTe}$ single crystals (with $\mathrm{x} = 0.48\%$ and 0.60%) was measured at $T = 20$ mK with different field orientations. Magnetization steps (MST's) arising from $\mathrm{Ce^{3+}}$ pairs were clearly observed for both samples. An isotropic MST observed at low fields is associated with one type of $\mathrm{Ce^{3+}}$ pairs. Another structure of MST's at higher fields, which depend on field orientation, is attributed to a second kind of $\mathrm{Ce^{3+}}$ pairs with anisotropic exchange interaction. The present data, along with previous ones on $\mathrm{Pb_{1-x}Ce_xS}$ and $\mathrm{Pb_{1-x}Ce_xSe}$, strongly support that both types of pairs consist of nearest-neighbors $\mathrm{Ce^{3+}}$-ions. This singular behavior has, so far, only been observed in these Ce-based IV–VI diluted magnetic semiconductors.

25CP27 Mechanism of Carrier-Induced Ferromagnetism

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Taking into account both random impurity distribution and thermal fluctuations of localized spins, we have performed a model calculation for the carrier (hole) state in $Ga_{1-x}Mn_xAs$ by using the coherent potential approximation (CPA). The result reveals that a *p*-hole in the band tail of $Ga_{1-x}Mn_xAs$ is not like a free carrier but is rather virtually bounded to impurity sites. The hopping of the carrier among Mn sites causes the ferromagnetic ordering of the localized spins through the double-exchange mechanism. The Curie temperature obtained by using conventional parameters agrees well with the experimental result.

25CP28 Low temperature magnetization and exchange interaction in $\mathrm{Sn_{1-x}Gd_xTe}$

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Recent literature has reported two exchange constants for Gd pairs in $\mathrm{Sn_{1-x}Gd_xTe}$: $J \approx -0.5$ K, attributed to superexchange, and $J \approx -1$ K, attributed a RKKY-type interaction. According to this interpretation, the dominant mechanism is determined by the hole concentration. We report magnetization measurements at 20 mK on three Bridgman grown samples of $\mathrm{Sn_{1-x}Gd_xTe}$. Magnetization ramps consistent with $J \approx -0.4$ K are present in the experimental traces of all three samples. However, one of the samples shows an additional ramp, consistent with $J = -1.1$ K. The coexistence of the two types of Gd-pairs in a single sample is intriguing in view of the current interpretation for the exchange mechanisms in this material.

25CP29 Ferromagnetism in the new diluted magnetic semiconductor p-$\mathbf{Bi_{2-x}Fe_xTe_3}$

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The ferromagnetic phase was found in the new diluted magnetic semiconductor of p-$Bi_{2-x}Fe_xTe_3$ ($0 \leq x \leq 0.08$) at a temperature T_c which increases with Fe content x up to T_c=12 K for x=0.08. The easy-axis for magnetization is parallel to the C_3 crystallographic axis. In n-type samples $Bi_{2-x}Fe_xSe_3$ ferromagnetic transition was not found down to 2 K. Clear de Haas-van Alphen effect was observed. Frequency of oscillation decreases with Fe doping, that is Fe atoms exhibit donor properties. With an increasing the content x of Fe atoms the value of the Seebeck coefficient α increases.

NMR study of enriched ^{195}Pt metal **25CP30**

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The natural Pt metal has many isotopes. Among them only ^{195}Pt has the nuclear spin, I=1/2. The Pt metal is the ideal system to investigate the concentration dependence of the nuclear spin order without changing the electronic properties. The NMR measurement was performed in the enriched 98% ^{195}Pt metal. The value of T_1T was the same as one in the natural Pt. However T_2 in the enriched Pt was shorter than one in the natural Pt. We also observed the magnetic field dependence of T_2 in the enriched Pt. The nuclear spin order of the enriched ^{195}Pt will be fully discussed.

Magnetism of decagonal $Al_{69.8}Pd_{12.1}Mn_{18.1}$ **25CP31**

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We report the results of measurements of ^{27}Al NMR spectra and the corresponding spin-lattice relaxation rates as well as of the dc susceptibility of polycrystalline decagonal quasicrystalline $Al_{69.8}Pd_{12.1}Mn_{18.1}$. The temperature-variation of the magnetic susceptibility $\chi(T)$ and the ^{27}Al NMR-spectra imply that a fraction of approximately 25% of the Mn-atoms carry a magnetic moment, and that a spin-glass-type freezing of these Mn moments occurs at $T_f = 12$K. The NMR spectra reveal two partially resolved lines for the ^{27}Al nuclei, indicating that there are two different sets of local environments for the Al-sites. Below 100K, the spin-lattice relaxation rate $T_1^{-1}(T)$ increases with a progressively increasing slope with decreasing temperature, indicating a slowing down of the fluctuations of the Mn moments, as it is often observed in relation with spin-glass freezing processes.

^{59}Co NMR in $ErCo_3$ **25CP32**

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NMR measurements of ^{59}Co in ferrimagnetic $ErCo_3$ have been carried out between 4.2 and 120 K and in external fields up to 8 T. The zero field powder spectrum at 4.2 K shows three resolved lines at 21, 65, and 96 MHz. In a field along the c-axis the two lower frequencies decrease, while the upper line increases smoothly at 10 MHz/T. It means that the Co-sublattices form an antiferromagnetic structure, which is in contrast to the standard interpretation of the neutron diffraction results. The temperature dependence of the upper line gives strong indication that the Co-moment of this sublattice changes at 100 K discontinuously to a smaller value above the metamagnetic transition at 100 K.

25CP33 Complex Magnetism in Fe_2VSi

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Magnetic susceptibility and ^{51}V NMR measurements are reported for two samples of Heusler-type Fe_2VSi; one was quenched after annealing at 1073 K (sample No.1) and the other was quenched after annealing at 1123 K (sample No.2). The susceptibilities of both samples have been found to depend strongly on static magnetic field applied. A new magnetic transition was found at 300 K for the sample No.2. The origin of the NMR line widths of ^{51}V is discussed to be due to hyperfine fields from ferromagnetic iron clusters in both crystals.

25CP34 ^{133}Cs Nuclear Spin-Lattice Relaxation on Field Induced Two-Step Phase Transition in Singlet-Ground-State Antiferromagnet $CsFeBr_3$

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In order to study the spin dynamics associated with the field induced two-step phase transition, we have performed an NMR experiment on ^{133}Cs in $CsFeBr_3$ under magnetic fields applied along the c-axis. The phase transition temperatures $T_{\rm N1}$ and $T_{\rm N2}$ were determined from the anomalies in the temperature dependence of the nuclear spin-lattice relaxation rate T_1^{-1}. The transition points $T_{\rm N1}$ and $T_{\rm N2}$ thus obtained are consistent with those determined by the specific heat and the magnetization measurement.

25CP35 Observation of the orbital ordering in $PrNiO_3$

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$PrNiO_3$ exhibits a metal-insulator (MI) transition associated with antiferromagnetic ordering at 135 K, the mechanism of which being in controversy. The charge density distributions in $PrNiO_3$ were shown by Maximum Entropy Method (MEM) analyses of the synchrotron X-ray powder diffraction data above and below the MI transition temperature. As a result, it was suggested that the orbital ordering was the origin of the Insulating behavior.

Elastic Properties of Ferromagnetic Mott Insulator $YTiO_3$ 25CP36

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$YTiO_3$, which has a $GdFeO_3$-type orthorhombic structure, has attracted interests because of a Mott insulator with a ferromagnetic transition at $T_c \simeq 29$ K. We have measured temperature dependence of elastic moduli for a high-quality single-crystal of $YTiO_3$ using an ultrasonic phase-comparison technique, and found an anomalous enhancement below T_c in the C_{44} mode, which is the linear response to the ϵ_{yz} strain. This result suggests that the ferromagnetic ordering has relevance to an orbital ordering of the d-electron t_{2g} state for a cubic symmetry.

Thermal expansion measurement of ferro-quadrupole ordering in HoB_6 25CP37

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Rare-earth hexaboride HoB_6 shows a ferro-quadrupole ordering of O_{yz},O_{zx} and O_{xy} with Γ_5 symmetry at T_Q = 6.1 K. The elastic constant C_{44} shows a huge softening of 80% above T_Q. The structural phase transition from cubic to trigonal at T_Q is characterized by the spontaneous strain, ε_{yz}=ε_{zx}=ε_{xy}, which is caused by the ferro-quadrupole ordering of O_{yz}=O_{zx}=O_{xy}. In order to examine the order parameter in HoB_6, we have performed the thermal expansion measurements along [001] as well as [111] directions. The lattice length along [111] shrinks appreciably $\Delta L/L$ = -4.5$\times 10^{-3}$. This result confirms the cubic-trigonal transition at T_Q obtained by the neutron scattering experiments.

Ultrasonic Study of Antiferro-quadrupole Ordering in HoB_2C_2 25CP38

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Elastic properties of the ternary rare earth compound HoB_2C_2 with a tetragonal structure have been investigated by ultrasonic measurements. The elastic constants of the transverse modes exhibit considerable softening below about 40 K towards the antiferro-quadrupole phase at T_{C2} = 5.0 K. In order to analyze the quadrupole susceptibility, we assume a model consisting of a ground E-doublet and an excited A or B-singlet. These softenings are commonly enhanced associated with increasing ultrasonic attenuation coefficients in the ordered phase IV.

25CP39 Elastic Properties of the Kondo Compounds $Ce_xLa_{1-x}B_6$ (x = 0.75 and 0.70)

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In order to elucidate the character of phase IV in $Ce_xLa_{1-x}B_6$ (x = 0.75, 0.70), we have made ultrasonic and thermal expansion measurements at low temperatures. The huge elastic softening and considerable attenuation of the transverse C_{44} mode are commonly observed in phase IV of both compounds. An expansion along [100] and a shrink along [111] in phase IV of both compunds indicate the lattice distorition from cubic to trigonal structure. Candidiates for an order parameter in phase IV are argued.

25CP40 Mechanism of Resonant X-Ray Scattering in DyB_2C_2

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For making clear the relation between the resonant x-ray scattering (RXS) signal and the quadrupole order, we calculate the RXS spectra near the Dy $L_{\rm III}$ absorption edge in the antiferro-quadrupole (AFQ) ordering phase of DyB_2C_2. Using a microscopic model that the $4f$ states of Dy are atomic while the $5d$ states form an energy band with a reasonable density of states, we obtain sufficient RXS intensities on the AFQ superlattice spot assuming the quadrupole order in the $4f$ states but without any lattice distortion, in good agreement with the recent experiment. The present result demonstrates the mechanism that the intensity is brought about by the modulation of $5d$ states through the anisotropic term of the $5d$-$4f$ Coulomb interaction.

25CP42 X-ray measurement for the orbital ordering materials

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By using our developed x-ray diffraction measuring system below 1K, we have studied the orbital ordering materials of PrPtBi, $Ce_{0.75}La_{0.25}B_6$ and $PrPb_3$. The ground state of the cubic semiconductor compound PrPtBi is a non-magnetic doublet. To investigate whether the phase below the transition temperature T_Q=1.35K is AFQ or FQ type, we have studied this material. The splitting of the (400) reflection peak was observed below the transition temperature. The ground state of $Ce_{0.75}La_{0.25}B_6$ is a quartet. The Phase between 1.4K and 1.7K is still unknown. Below the transition temperature 1.7K, we have observed that the FWHM decreases and the intensity of the x-ray peak are increases.

Cu K-edge resonant X-ray scattering in $KCuF_3$ **25CP43**

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We study the Cu K-edge resonant x-ray scattering (RXS) spectra in $KCuF_3$ by using LDA+U band structure calculation. The calculated spectra show good agreement with the experiments. We discuss the origin of the RXS intensity by connecting with the crystal and electronic structures. The RXS intensity in the main K-edge region reflects mainly the Jahn–Teller distortion, while that in the pre-K-edge region the Cu $3d$ orbital polarization. The effect of the quadrupole transition is found to be one order of magnitude smaller than the dipole transition.

Quadrupole and magnetic spin-lattice relaxation of ^{209}Bi in $Bi_4Ge_3O_{12}$ **25CP44**

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The nuclear spin-lattice relaxation was studied in the $Bi_4Ge_3O_{12}$ single crystal by ^{209}Bi NQR. Experimental recovery curves for all ^{209}Bi NQR transitions of nuclear spin I=9/2 in the temperature range 10-230K were described by the single effective spin-lattice relaxation time $T_1{}^*$. The temperature dependence of $1/T_1{}^*$ was close to T^n law with n=2.4-2.7. Theoretical treatment was given for the nuclear spin-lattice relaxation in the multi-level system for the case of single-axial crystalline electric field. Both quadrupole and magnetic mechanisms of relaxation were taken into account. It was shown that magnetic mechanism contributes noticeably to the spin-lattice relaxation in $Bi_4Ge_3O_{12}$ at T$\leq$50K.

On the Quadrupole Ordering in $PrPb_3$ **25CP45**

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$PrPb_3$ is known as a prototype system showing antiferro-quadrupole oredering (AFQO) below T_Q =0.4K. The ground state is non-magnetic Γ_3 doublet states, which is accompanied by quadrupole moments. AFQO is brought by spontaneous splitting of the Γ_3 doublet states. In $PrPb_3$, excited Γ_4 triplet states lie above Γ_3 states with splitting of 19K. Then, at and below T_Q, we can neglect the states other than the Γ_3 doublet states and regard them as two states of spin 1/2. The quadrupole interaction between two Pr ions turns to the 3D XY Hamiltonian. This correspondence allows us to discuss the low T properties as well as the impurity effect of $PrPb_3$[1]. Nuclear spin ordering coming about on the AFQO is also discussed.

[1] T. Kawae, M. Shimogai, M. Mito, K. Takeda, H. Ishii, and T. Kitai, Phys. Rev. B65, 012409 (2002).

25CP46 Phonon anomaly in the inorganic spin-Peierls compound $CuGeO_3$

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By the inelastic neutron scattering experiment the longitudinal optical phonon branch (b*-LO) was measured at (030) and E=1 meV. The temperature dependence of the integral intensity decreases exponentially below 150 K. This anomalous phenomena is related to the spin-Peierls transition at 14 K that can be explained as not translation type but as order-disorder type of oxygen atoms.

25CP47 Effects of quantum lattice vibration on the spin-Peierls transition

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The lattice degree of freedom is quantized in a Monte Carlo study of S=1/2 spin-Peierls transition. The lattice deviation is treated as continuous variable and we used the method introduced Hirsh et al. We combined the loop algorithm spin part and thus we can study the properties even at low temperature. First we study the ground state lattice fluctuation where the system shows a characteristic structure function. We also study the mass dependence of the physical quantities, e.g. the magnetic susceptibility. For large mass, the system shows the same behavior as the case of the classical lattice vibration. On the other hand, for light mass, the susceptibility coincides with the uniform (constant coupling) spin system. We investigate the physical mechanism of this behavior and propose the picture 'quantum narrowing'.

25CP48 Enhancement of the Thermal Conductivity in gapped Quantum Spin Chains

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We study mechanism of magnetic energy transport, motivated by recent measurements of the thermal conductivity in low dimensional quantum magnets. We point out a possible mechanism of enhancement of the thermal conductivity in gapped magnetic system, where the magnetic energy transport plays a crucial role. We study thermal conductivity in spin systems using quantum master equation. This mechanism gives an interpretation for the recent experiment of $CuGeO_3$, where the thermal conductivity depends on the crystal direction. We also discuss the possibility of ballistic energy transport in alternate spin chains considering the Green-Kubo formula.

Magnetic ordering of quasi-1 D S=1/2 Heisenberg antiferromagnet Cu-benzoate at sub mK temperatures **25CP49**

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We have measured ac susceptibility and magnetization of quasi-1D S=1/2 Heisenberg antiferromagnet Cu-benzoate at temperatures down to 0.2mK by Cu nuclear demagnetization refrigration. A sharp susceptibility peak is observed at 0.8mK under an earth field. The susceptibility peak shows 3D ordering of linear chains coupled by weak magnetic interactions between chains.

Low-Temperature $Zigzag$ Charge Ordering Structure of α'-NaV_2O_5 **25CP50**

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The low-temperature (LT) superstructure of NaV_2O_5 was determined by synchrotron radiation X-ray diffraction. Below the phase transition temperature at 34 K, the LT structure is monoclinic. It was determined that the LT structure is $(a-b)\times 2b\times 4c$ with the space group $A112$, where a, b and c represent the high-temperature orthorhombic unit cell. The valence estimation of V ions shows that the V sites are clearly separated into two groups of V^{4+} and V^{5+} with a zigzag charge-ordering pattern.

Random Quantum Chain System: Mixture of $S=1/2$ Antiferromagnetic Chains with Uniform and Alternating Couplings **25CP51**

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Cu(γ-pic)$_2$Cl$_{2x}$Br$_{2(1-x)}$($0\leq x\leq 1$) [γ-pic=4-Methylpyridine] is a $S=1/2$ Heisenberg antiferromagnetic uniform ($x=0$) or alternating ($x=1$) chain system. We report the results of susceptibility, high-field magnetization, and ESR measurements of the mixed systems in which the alternating ratio as well as the intrachain interaction is systematically changed. The effect of randomness on the ground state properties is discussed.

25CP52 Effect of Staggered Field in $S = 1/2$ Antiferromagnetic Chain: Copper Pyrimidine

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We report electron spin resonance and magnetization measurements of the $S = 1/2$ antiferromagnetic Heisenberg chain Cu pyrimidine, $[PM{\cdot}Cu(NO_3)_2{\cdot}(H_2O)_2]_n$(PM=pyrimidine). The effect of staggered fields due to both the alternating g-tensor and the Dzyaloshinskii-Moriya interaction is clearly observed.

25CP53 Magnetic Properties of Bond-Alternating Quantum Spin Chain Systems: $(CH_3)_2NH_2CuX_3$(X=Cl,Br)

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The magnetic behavior of uniform spin 1/2 quatnum Heisenberg chains has been well documented, for both ferromagnetic (F) and antiferromagnetic (AF) exchange coupling. We are interested in a bond-alternating chain system in which F and AF couplings are comparable. Our model substances are $DMACuX_3$ where DMA=$(CH_3)_2NH_2$ and X=Cl and Br. We report the results of ESR, magnetic susceptibility, specific heat, and high-field magnetization.

25CP54 Magnetic Property of $Ba_2CoGe_2O_7$

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We studied a two-dimensional antiferromagnet (S = 3/2), $Ba_2CoGe_2O_7$, which is isostructural to S = 1/2 antiferromagnet, $Ba_2CuGe_2O_7$. A single crystal of $Ba_2CoGe_2O_7$ was obtained and the magnetization and heat capacity measurements were performed. A weak ferromagnetism is observed below 6.7 K in $Ba_2CoGe_2O_7$, while $Ba_2CuGe_2O_7$ is a two-dimensional spiral antiferromagnet due to Dzyaloshinskii-Moriya interaction [1]. The different spin structures between $Ba_2CoGe_2O_7$ and $Ba_2CuGe_2O_7$ are presumed to be due to the different spatial configurations of D vector.
[1] A. Zheludev *et al.*, Phys. Rev. B **54**, 15163 (1996); *ibid.* **59**, 11432 (1999).

Raman-Scattering Study on Revival of the Spin-Peierls Transition in Heavily Mg-Doped $CuGeO_3$ under High Pressures **25CP55**

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Raman-scattering study has been carried out in 3.5% Mg-doped $CuGeO_3$ crystals under high pressures at low temperatures. This sample does not undertake the spin-Peierls (SP) transition at ambient pressure. The folded phonon modes and the two-magnetic-excitation bound state, however, appear under high pressures. The SP gap mode is also observed. These facts show that the SP phase transition is revived by applying pressures. We observe a new phonon peak above 2.8 GPa together with the SP gap and the folded phonon modes at low temperatures, indicating a pressure-induced structural phase transition. This new peak remains observable far above $T_{\rm SP}$. We propose a P-T phase diagram for this sample.

Magnetism of a New Spin Gap Material **25CP56**

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We obtained new spin-gap materials, $NaV(WO_4)_2$ and $LiV(MoO_4)_2$. The magnetic ion is V^{3+} ($3d^2$, S = 1). $NaV(WO_4)_2$ is isostructural to $NaIn(WO_4)_2$ [1]. A zigzag chain of VO_6 octahedra is along the c axis and the spin chain is separated by a zigzag chain of NaO_6 octahedra in the a direction. The V^{3+} - V^{3+} distance along the b axis is about twice as long as that of the c axis and, therefore, the system is expected to be quasi one-dimensional spin system. We measured the magnetic susceptibility and heat capacity on the polycrystalline samples of these materials. The susceptibility of both materials shows a drastic decrease at low temperature and the existence of spin gap is concluded.
[1] P. V. Klevtsov et al., J. Solid State Chem. 2, 278 (1970).

Low-temperature structure of $NaTiSi_2O_6$ with a spin-singlet ground state **25CP57**

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$NaTiSi_2O_6$ is a spin-1/2 system in the quasi-one-dimensional magnets, pyroxene family. We observed a phase transition at 210K, which was accompanied by the structural change and the spin-singlet formation. The structure of the low temperature phase was studied by x-ray and neutron powder diffraction. We obtained an evidence for the formation of Ti^{3+}-Ti^{3+} dimers. We will discuss the relevance to a spin-Peierls like phase transition.

25CP58 Nuclear magnetic relaxation of ^{19}F in S=1/2 bond-alternating organic compound F_5PNN

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An organic compound F_5PNN is a good candidate for S=1/2 bond-alternating energy-gap system, which has two critical fields of H_{C1} = 2.5 T and H_{C2} = 6.5 T. The nuclear magnetic relaxation rate $1/T_1$ of ^{19}F for the critical field region ($H_{C1}<H<H_{C2}$) exhibited power-law behavior like $T_1^{-1} \sim T^{-0.6}$ below 1 K, deviating appeciably from the trend of rather moderate decrease with decreasing temperature, which may be an evidence for the realization of Luttinger-liquid state. The new splitting of resonance lines and an anomalous increase in T_1^{-1} appears around 0.2 K, which suggests an onset of 3D long-range order.

25CP59 Anomalous two-stage spin-flop transition in $BaCu_2Si_2O_7$

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An anomalous two-stage spin-flop transitions in antiferromagnet $BaCu_2Si_2O_7$ (T = 9.2 K) has been investigated in detail. The magnetic field applied along the c direction (an easy axis) induces the spin-flop transition at H_{c1} = 2 T followed by the second one at H_{c2} = 4.9 T. At H_{c1} spin flops roughly to the b axis, and then switches its direction to the a axis at H_{c2}. This behavior can be neither understood by a conventional spin-flop theory nor explained by the competition between symmetric inter-chain and antisymmetric DM interactions as was previously predicted. Oak Ridge National Laboratory is managed by UT-Battelle, LLC for the U.S. Department of Energy under contract DE-AC05-00OR22725.

25CP60 Zero-field Cooled Specific Heat of Stage 5 $FeCl_3$ Intercalated Graphite

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Previous ac and dc magnetic susceptibility and specific heat measurements on ferric chloride intercalated graphite compounds, in the temperature range $1.2 < T < 4.2$ K and a magnetic field $H \sim 0.5$G, have shown them to undergo a phase transition ~ 1.8 K, for all stages 1 through 6 and 8. Here, specific heat measurements on a stage 5 sample, that was cooled in zero magnetic field as generated by a μ-metal magnetic shield, have been carried out down to below 0.5 K. In these measurements the specific heat anomaly is lowered to the temperature $T \sim 0.9$ K. Further, the removal of the magnetic shield does not restore the higher temperature anomaly, even after the sample's temperature was raised above 10 K. The data also show a T^2 behavior above 1.5 K for the lattice component ($\theta_D \sim 150$ K), which is indicative of a $2D$ phonon spectrum.

Temperature and Magnetic-Field Dependencies of Magnetic Excitations of Spin-Pair System $KCuCl_3$ 25CP61

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Temperature and magnetic-field dependencies of magnons of a spin-pair system $KCuCl_3$ are investigated by the pair mean-field approximation. As for the temperature dependence the lowest magnon energy (gap energy) shows significant softening as temperature is lowered. However, the softening is incomplete, or the gap remains finite, down to T = 0 K, and hence no long range order is occurred. When magnetic field is applied, it acts to suppress the gap energy. As the results complete softening is occurred at finite temperatures for a certain range of magnetic field strength, and a long range order is realized. Occurrence of long range order under magnetic field in $KCuCl_3$ has been confirmed experimentally and the lower and upper critical fields at T = 0 K estimated by us are in good agreement with the observations.

Impurity doping effects in Haldane gap system Y_2BaNiO_5 25CP62

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Impurity (and carrier) doping is a powerful probe to understand novel quantum spin liquid state realized in the Haldane gap system through a variety of impurity induced phenomena; i) edge spins, their exchange interaction (with impurity spins), and finite chain effect, and ii) possible antiferromagnetic ordering as observed in spin Peierls and spin ladder systems. We will present new features observed in the specific heat $C(T, H)$ of Mg (nonmagnetic impurity) and Ca (S=1/2 carrier) doped Y_2BaNiO_5 single crystals under magnetic fields applied parallel to three crystallographic axes of the crystals. These results indicate that the understanding of edge state is still far from complete.

Field–Induced Magnetic Ordering in $TlCuCl_3$: Lattice Deformation and Features of First–Order Transition. 25CP63

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We report on the NMR and strain–gauge study of the field–induced magnetic ordering in a zigzag chain spin–gap material $TlCuCl_3$, which is understood as Bose–Einstein condensation of dilute magnons. The results indicate lattice distortion at the transition. Moreover, NMR shows that the build–up of the magnetic order is discontinuous, and that the ordered and disordered phases coexist at the phase boundary. This indicates that the transition, which is magnetic by nature, has first–order features.

25CP64 NMR Study of Magnetic Structures in NH_4CuCl_3

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In order to clarify the magneic structure of NH_4CuCl_3, nuclear magnetic resonance and relaxation of ^{15}N (I=1/2) were measured, using an enriched single crystal, in the field regions below the first critical field H_{C1}= 5 T and on the first magnetization plateau above H_{C1}. From the temperature dependencies of the NMR spectrum and T_1^{-1} obtained from 1.4 K to 120 K, it is proposed that magnetic moments associated with triplet state of one Cu-dimer appears per every four Cu-dimers along the a-axis up to 8.5 K in both field regions. Such a magnetic structure seems to change at higher temperatures, thus suggesting that this sytem exhibits some magnetic phases depending on the values of external field and temperature.

25CP65 Tunneling Experiments on Manganites and Cuprates in Normal State

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Conductance data for LaCa(Sr) manganites / Bi2212 cuprates - natural barrier - Ag are presented. Small deviations from the overall parabola-like dependence on voltage were revealed. An important role of outdiffusion of the weak Cu-O and Mn-O bond oxygen is shown. It is demonstrated the presence of the broad range of high energy excitations that are localized in barrier and transition regions of tunnel contacts. Results for spectral function of electron-phonon interaction of metaloxides are in qualitative agreement with the data from neutron and Raman experiments. The possible effect of these exitations on the TMR is analysed.

25CP66 The Enhancement of TMR in Ferromagnetic SET

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Several years ago, we found the tunnel magnetoresistance (TMR) of a single-electron transistor made of Ni and Co was greatly enhanced when the Coulomb blockade was effective at low temperatures. Later, similar enhancement was reported in granular film of ferromagnetic metal. In this paper, we will report the subsequent experimental results on this subject. We investigated how the enhancement changes as a function of the tunnel resistance, and found that the same factor of enhancement exists even for very resistive devices, which is not explained by the theories of enhancement based on the higher-order tunneling.

Exact-diagonalization Study of Thermoelectric Response in Strongly Correlated Electron Systems **25CP67**

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We have studied the thermopower and resistivity based on the Hubbard model with strong on-site Coulomb interaction and orbital degeneracy by using exact diagonalization method. It is shown that the thermopower is strongly enhanced by the spin and orbital degrees of freedom, but the resistivity is significantly less affected. We apply our theory to the thermoelectric response of $NaCo_2O_4$ where the large thermopower and low resistivity have been discovered by Terasaki *et al*. [Phys. Rev. B **56**, R12685 (1997).] Our theory suggests that the spin and orbital degeneracy of 3d electrons is responsible for the large thermopower in $NaCo_2O_4$. A key for the strategy of new thermoelectric materials in transition metal oxides is proposed in the light of the theory.

Electrical Resistivity and Photoemission Spectra of $(La_{1-x}Ca_xO)Cu_{1-x}Ni_xS$ **25CP68**

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Temperature dependence of electrical resistivity of layered oxysulfide $(La_{1-x}Ca_xO)Cu_{1-x}Ni_xS$ changes from semiconducting to metallic character with x successively, accompanied with the appearance of new density of states in the vicinity of Fermi energy found in photoemission spectra. The sample of $x = 0.03$ shows a semiconductor to metal transition with no specific heat anomaly at 150 K. This may be attributed to the anisotropic resistivity caused by insulating LaO layer and metallic Ni-doped CuS layer. A resistivity increase proportional to log$T$ is observed for $x = 0.03 \sim 0.06$ at low temperature.

Thermal Transport of Cr-doped Double-Layered $LaSr_2Mn_2O_7$ **25CP70**

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We have studied thermoelecric power (S) , magnetization and magnetoresistance of $LaSr_2Mn_{2-y}Cr_yO_7$ compounds (y=0.1, 0.2 and 0.4). For the parent material $LaSr_2Mn_2O_7$, it is well known that the coexistence of metallic A-type antiferromagnetic (AF) phase and CE-type charge order (CO) phase is essential to understand the transport properties. Near the AF/CO transition temperature, the observed peak in S shifted to lower temperatures with Cr-doping. The Cr-doping at Mn-site in layered manganite systems did not cause such a dramatic influence as the insulator to metal transition in cubic manganites. This finding is discussed on the basis of two-phase separation .

25CP71 $\mu\mathcal{SR}$ STUDIES ON THERMOELECTRIC OXIDES

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To investigate the role of magnetism on transport properties of thermoelectric oxides, μSR spectroscopy has been used for polycrystalline $Ca_3Co_4O_9$, $Na_{0.7}CoO_2$ and $Sr_{1-x-y}Ca_xGd_yMnO_3$ samples in the temperature range between 290 and 2.5 K. It was found that $Ca_3Co_4O_9$ exhibits an incommensurate spin density wave transition around 100 K, though $Na_{0.7}CoO_2$ indicated no magnetic transitions below 250 K. The $Sr_{1-x-y}Ca_xGd_yMnO_3$ sample showed an obvious magnetic transition below 250 K, while a muon precession was not observed even at 2.5 K probably due to an inhomogeneous distribution of the internal magnetic field.

25CP72 The out-of-plane magneto-resistivity of $Sr_3Ru_2O_7$

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We present measurements of the c-axis resistivity as a function of magnetic field for the bilayered ruthenate $Sr_3Ru_2O_7$. It has been established that this material displays itinerant electron metamagnetism. Here, we show that like our published work on the in-plane magnetoresistance, the out-of-plane magnetoresistance has features that are clearly identifiable with the metamagnetism at identical fields. However, the out-of-plane magnetoresistance appears to have a strong dependence on crystal quality, which may provide a reason for the discrepancy between our findings and those of others.
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25CP73 Magnetotransport Properties and Lattice Effects of Cr-Doped $Nd_{0.45}Sr_{0.55}MnO_3$ Perovskite

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The effect of Cr-doping on the Mn site in the perovskite $Nd_{0.45}Sr_{0.55}MnO_3$ has been studied by using the magnetization, magnetoresistance, thermal expansion and magnetostriction measurements. Mother material changes from paramagnetic semiconducting state (PMS) to antiferromagnetic metallic one (AFM) at $T_{N(M)}$=230 K. 5 at.% Cr-doped material changes from PMS to ferromagnetic metallic state (FMM) at T_C=250 K and then to antiferromagnetic insulating one (AFMI) at $T_{N(I)}$=140 K. Either the application of 7T magnetic field or additional 5 at.% Cr-doping on this material completely suppresses the AFMI keeping the FMM down to the lowest temperature (10K) measured. Observed characteristic anomalies near $T_{N(M)}$, T_C and $T_{N(I)}$ indicate strong correlation between d-electron e_g state and lattice state.

Anomalies of electro- and magnetotransport in Heusler-like alloys $Fe_{2-x}V_{x+1}Me$ (Me = Al,Ga) 25CP74

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Electro- and magnetoresistivity, Hall effect, magnetic and optical properties of Heusler-like alloys
$Fe_{2-x}V_{x+1}Me$ (x = 0, 0.1, 0.2; Me = Al,Ga) were studied in the temperature range from 4.2 to 400 K and in magnetic fields up to 15 T. Anomalies in the temperature dependence of the resistivity and the Hall coefficient were observed, which correlate with the peculiarities of the optical properties. The results are discussed in the frame of existing theoretical concepts.

Tunneling Magnetoresistance of Phase-Separated Manganites 25CP75

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The effect of phase separation on temperature and magnetic field dependence of magnetoresistance (MR) is analyzed for non-metallic manganites. The material is modeled by a system of small ferromagnetic metallic droplets in an insulating matrix. The charge transfer is supposed to be due to the electron tunneling between droplets. The MR in such a system is caused by the change in the tunneling probability with magnetic field H due both to the increase in the size of droplets and to the mutual orientation of their magnetic moments. It is shown that at small H the MR is proportional to H^2 and decreases with temperature as $1/T^n$, where n can vary from 1 up to 5 depending on parameters of the system. At higher fields, the growth of MR with H first becomes slower and then MR increases exponentially.

In-plane Field Induced Structural Change of Magnetic Domains in Layered Manganite $La_{1.36}Sr_{1.64}Mn_2O_7$ 25CP76

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We present a study of structural change of the magnetic domains in $La_{1.36}Sr_{1.64}Mn_2O_7$ using magneto-optical effect of a garnet film mounted on the ab-plane of a crystal. The maze domain formed below 65 K changes into the stripe domain elongated along field direction by applying in-plane field. Under an offset field perpendicular to the plane, however, the domain pattern changes into bubbles. These domain patterns are stable even after removing the field. The in-plane field needed for such structural change becomes small at higher temperatures and the size of the formed domains depends on the thickness of the sample. These changes are similar to those observed in bubble garnet film. The effect of the domain structure on magneto-transport properties will also be discussed.

25CP77 Stractual analysis and magnetic properties of Fe/Bi system

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Only a few studies have been reported for Fe/Bi system, so far, due to the difficulty of the crystal growth. We have succeeded to grow up both Fe/Bi multilayers and trilayers by using MBE method. The structual and magnetic properties of these films were investigated by using XRD, XRR,XPS and SQUID.
We have devised the samples by Forcused Ion Beam apparatus to measure magnetoresistance. A distinct kink was observed in magnetization curves, and negative MR effect was also observed in CIP-MR measurements. We will report and discuss the growing condition of the Fe/Bi multilayers and the interlayer Bi thickness dependence of magnetic properties.

25CP78 Relationship between tarnsport properties and magnetic state of $Sm_{1-x}Sr_xMnO_3$ manganites

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The thermal conductivity, thermoelectric power, thermal diffusivity, specific heat and electrical resistivity of $Sm_{1-x}Sr_xMnO_3$ polycrystals have been studied as a function of temperature (77-300 K), magnetic field (0-26 kOe) and Sr doping. Close T_C measured properties shows anomalies induced by the transition at Curie point. Temperature and concentration dependences of the studied coefficients are consistent with magnetic and neutron diffraction studies, in according to which below T_C in $Sm_{1-x}Sr_xMnO_3$ around x=0.45 the homogeneous ferromagnetic state is implemented without explicit antiferromagnetic indications, and in samples with x=0.40 and x=0.50 the phase-separated state is observed.

25CP79 Zn-Substitution Effects on the Thermal Conductivity of the Two-Dimensioinal Spin-Gap System $SrCu_2(BO_3)_2$ and the Two-Dimensional Antiferromagnetic System $Cu_3B_2O_6$ Single-Crystals

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We have measured the thermal conductivity κ parallel to the two-dimensional plane of $SrCu_{2-x}Zn_x(BO_3)_2$ (x = 0, 0.02) and $Cu_{3-x}Zn_xB_2O_6$ (x = 0, 0.03) single-crystals grown by the TSFZ method. The κ exhibits an anomalous peak in the spin gap state of $SrCu_2(BO_3)_2$ and also in the antiferromagnetic ordered state of $Cu_3B_2O_6$. Through the partial substitution of Zn for Cu, the peak does not change in the former, while it is strongly reduced in the later. It has been concluded that the peaks observed in $SrCu_2(BO_3)_2$ and $Cu_3B_2O_6$ are regarded as the contribution of phonons and magnons, respectively.

Fabrication and magneto-transport properties of $La_{2-2x}Sr_{1+2x}Mn_2O_7$ $(x = 0.3)$ thin films **25CP80**

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Concerning from the crystal structure, layered perovskite $La_{2-2x}Sr_{1+2x}Mn_2O_7$ (LSMO327) can be considered as an infinite array of ferromagnetic tunneling junctions. This leads to a gigantic tunneling magnetoresistance effect along the c-axis direction in the composition of $x = 0.3$. So far, there has been a report for fabrication of LSMO327 $(x = 0.4)$ thin films on $SrTiO_3$ substrates by Konishi *et al.*, but none for thin films of LSMO327 $(x = 0.3)$. It is also well known that properties of manganite thin films change dramatically due to the lattice mismatch with the substrates. Therefore, substrate with little mismatch as $SrTiO_3$ is usually used. Here, we have grown LSMO327 $(x = 0.3)$ thin films by PLD on MgO(100) substrates, which we expect a strain free growth, and measured their magneto-transport properties.

Hall effect in $La_{0.7}Ca_{0.3}MnO_3$ **25CP81**

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The Hall coefficients for $La_{0.7}Ca_{0.3}MnO_3$ epitaxial films with perovskite structure have been measured between 4.2K and 300K. The ordinary Hall coefficients above nearly 150K had the positive sign but those below this temperature showed the negative sign. The anomalous part of the Hall coefficients depended on the temperature and the magnetic field.

Unconventional electronic transition in Na_xCoO_2 with a precisely controlled Na nonstoichiometry **25CP82**

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We discovered an unconventional electronic transition in a layered cobalt oxide, Na_xCoO_2, with a precisely controlled Na content. Only for Na-rich samples with, e.g. x = 0.75, a weak-ferromagnetic transition of the second order was clearly detected at T_C = 22 K, being accompanied by a clear specific-heat jump, an expectedly small spontaneous magnetization, a kink in the resistivity ($\rho - T$) and thermopower ($S - T$) curves. Moreover, large positive magnetoresistance effect was observed at temperatures below T_C. In this contribution, the origin of this transition will be discussed.

25CP83 Doping Effect on Transport Properties of Layered Oxysulfide $Sr_2Cu_2CoO_2S_2$ with CoO_2 square planes

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Layered cobalt oxysulfide $Sr_2Cu_2CoO_2S_2$ crystallizes in an unusual intergrowth structure which represents a combination of $ThCr_2Si_2$ type $SrCu_2S_2$ and $Sr_{0.15}Ca_{0.85}CuO_2$ type $SrCoO_2$ units. $Sr_2Cu_2CoO_2S_2$ is a p-type antiferromagnetic semiconductor with T_N(=200K). And below T_t(=125K), the antiferromagnetic nature is changed from 2D to 3D. We studied Seebeck coefficient of $Sr_2Cu_2CoO_2S_2$ and its Cu-doped compounds. Their Seebeck coefficients near T_t tend to enhance by the Cu-doping into CoO_2 square planes. At the conference, we would like to report the doping effect on transport properties of $Sr_2Cu_2CoO_2S_2$ with the hybrid structures.

25CP84 Nonlinear Optical Response in two-dimensional Mott Insulators

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We theoritically examine the nonlinear optical responses in two-dimensional Mott insulators. The photoexcited states of the Mott insulators are described by an effective model in the strong-coupling limit of a half-filled Hubbard model. By comparing the linear optical absorption, nonlinear optical two-photon absorption and third harmonic generation (THG), we clarify the nature of photoexcited states such as the distribution of dipole-allowed and -forbidden states. In the THG spectrum, main contribution is found to come from the process of three-photon resonance associated with the dipole-allowed states . As a result, the two-photon resonance process is less prounced in the THG spectrum. The calculated THG spectrum is compared with recent experimental data.

25CP85 Transport and Magnetic properties of the micro-fabricated perovskite-type manganese oxides

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Wires and dots of the perovskite-type manganese oxides with the dimension of micrometer were fabricated by the electron-beam lithography and Ar-ion etching methods for those oxide thin films. The thin films were prepared by the pulsed laser deposition (PLD) method with a KrF excimer laser. A wire 1 μm in width showed a larger magnetoresistance than that of the thin film. Definite magnetic force microscope (MFM) images revealing a movement of the magnetic domains were observed for the square dots under an applied in-plane magnetic field.

Electron-Electron Interaction Effect on Conductivities in Cobalt Thin Films **25CP86**

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We have measured the temperature (T) dependence of the conductivity of cobalt films with various thickness (d). The conductivity shows lnT dependence for d$<$100Å, which is mainly caused by electron-electron interaction effect. The coefficient of the lnT dependence significantly decreases with decreasing thickness for d$<$50Å, where the conductivity approaches Mooij limit. The results suggest that the scattering for d$<$50Å is dominated by the inhomogeneity of the films such as grain boundaries.

Static and Dynamic transport study of β-$FeSi_2$ single crystals **25CP87**

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Even though β-$FeSi_2$ has received considerable attention as optical and thermoelectric devices, the fundamental understanding of its conduction carriers is still controversial. In order to get an insight on the transport properties, the static transport properties and the pulsed-laser-induced transient thermoelectric effect (TTE) of β-$FeSi_2$ single crystals have been measured. The Hall voltages and TTE signals clearly showed possible multiple conduction carrier systems. From these experimental results, the tentative band scheme is discussed.

Magnetic, Electrical and Thermal Properties of $La_{0.80}Sr_{0.20}(Mn_{1-Z}Co_Z)O_3$ **25CP88**

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$La_{0.80}Sr_{0.20}MnO_3$ and $La_{0.80}Sr_{0.20}CoO_3$ show the typical colossal magnetoresistance (CMR) below the ferromagnetic metallic (FM-M) transition temperature T_c. In both systems, the CMR effect is likely to be mediated by the double-exchange mechanism. In the $La_{1-X}Sr_XCoO_3$ system, there are additional complications related to the low-spin and high-spin states of Co ions and modulated structures consisting of the hole-rich and hole-poor regions. We fabricated the $La_{0.80}Sr_{0.20}(Mn_{1-Z}Co_Z)O_3$ mixed crystals and measured the magnetization, electrical resistivity, thermoelectric power and thermal conductivity. The FM-M state disappeared in mixed crystals in both sides (Z$\simeq$0, Z$\simeq$1) but the destruction effect is more drastic by far in the Co-side. We proposed the phase diagram for this system that was determined by the measured anomalies.

25CP89 Thermal Conductivity of $Pr_{0.65}(Ca_{1-Z}Sr_Z)_{0.35}MnO_3$ under Applied Field

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The perovskite manganite system $Pr_{0.65}(Ca_{1-Z}Sr_Z)_{0.35}MnO_3$ undergoes the transition from the charge /orbital ordered (CO/OO) insulating phase (Z<0.3) to the ferromagnetic metallic (FM-M) phase (Z>0.3), which is caused by the increasing one-electron bandwidth *W*. The antiferromagnetic CO/OO phase can be transformed to the FM-M phase also by applying the magnetic field. We measured the thermal conductivity $\kappa(T)$ and the thermal expansion dL(*T*)/L of the $Pr_{0.65}(Ca_{1-Z}Sr_Z)_{0.35}MnO_3$ system (0<Z<1.0) in applied field and found anomalies associated with the magnetic transition; $\kappa(T)$ was enhanced and dL(*T*)/L was decreased below the FM-M transition temperature T_c. These anomalies may originate from the relaxation of the Jahn-Teller lattice distortion as a result of the increasing carrier itinerancy in the FM-M phase.

25CP90 Co Site Substitution Effect on Thermoelectric Properties in $Na(Co_{1-X}M_X)_2O_4$ (M=Ni, Fe, Mn, Cu)

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$NaCo_2O_4$ has attracted much attention as a thermoelectric material because of the large thermopower (S$\simeq$100μV/K) in spite of the relative low electrical resistivity ($\rho \simeq$200$\mu\Omega$cm) at room temperature. In order to improve the thermoelectric properties, we investigated the Co site substitution effect on the sintered $Na(Co_{1-X}M_X)_2O_4$ polycrystals (M=Ni, Fe, Mn, Cu). The thermopower S and the thermal conductivity κ were measured by the steady-state heat-flow method from 10 to 300 K using an automated measuring system. The Co site substitution by Cu was the most effective in improving the thermoelectric properties and the figure of merit $Z=S^2/\rho\kappa$ increased with increasing X up to 0.2. The potential of this system as a thermoelectric material is discussed.

25CP91 NMR Studies of Co-Oxides with Large Thermoelectric Performance

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The electronic state of Co oxides, $NaCo_2O_4$, $Bi_{2-x}Pb_xSr_2Co_2O_y$ and $Ca_3Co_4O_9$ with large thermoelectric power S and low electrical resistivity ρ have been studied mainly by NMR, and following things have been found. (1) The T-dependence of the NMR spectra of $NaCo_2O_4$ clearly indicates that there exists structural phase change possibly caused by the rearrangement of Na atoms at $\sim$ 40K, where transport quantities also exhibit anomalous behavior. (2) The magnetic order found for $Bi_{2-x}Pb_xSr_2Co_2O_y$ below 20K is ferromagnetic one with the ordered moment of $\sim$ 0.1 μ_B/Co at low T. The order appears over a half volume of the sample. (3) Even though the magnetically active parts often have a significant volume, it seems to be due to lattice imperfections and the electron system will be basically itinerant and exhibits Pauli pramagnetic behavior.

Giant Magnetoresistance in Nanosize Magnetic Contacts **25CP92**

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The theory of conductance and magnetoresistance of nanoscale-size point contacts between ferromagnetic metals is developed. The theory predicts an essential increase of magnetoresistance when ballistic regime of electron transport is realized in the vicinity of the contact area. In the regime of quantized conductance through the contact a huge enhancement of magnetoresistance and giant fluctuations of its values are predicted. Recent experiments are discussed in the framework of our theory. The work was supported by Deutsche SFB 491 and BRHE grant REC-007.

Pressure Dependent Magnetization of $DyCu_2$ Single Crystals **25CP93**

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Some of the $R\mathrm{Cu}_2$ intermetallics show a magnetic axis conversion (i.e. the magnetic properties are exchanged completely between the original easy a and hard c axis) if a critical field parallel c is applied at low temperatures. It is associated with a stable change of the crystallographic structure and a giant magnetostriction (GMS) of some percent. This is caused by a strong magnetoelastic coupling. We investigated the pressure dependent magnetization of DyCu_2 up to 0.7 GPa. The magnetic anisotropy decreases with pressure resulting in a vanishing of the conversion effect at approximately 0.5 GPa. This is discussed in a microdomain structure model where pressurizing leads to an equal population of domains.

Transport properties of Cr and Fe doped $Sm_{1.4}Sr_{1.6}Mn_2O_7$ at low temperature **25CP94**

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The resistance and magnetisation of bilayer manganites $Sm_{1.4}Sr_{1.6}(Mn_{1-x}M_x)_2O_7$, M = Cr, Fe, x = 0.0, 0.01, 0.05 are investigated at low temperature down to 4.2 K under different magnetic fields upto 4 Tesla. The parent compound for x = 0.0 exhibits metal - insulator transition (M-I) at about T_{MI} = 112 K. The replacement of Mn by Cr reduces M-I transition to 60 K. The substituion of Mn by Fe drastically affects the resistivity at low temperature. The resistivity increases sharply below 100 K and does not show any maximum down to 50 K. The application of magnetic field induces M-I transitiom around 60 K. A large magnetoresistance (99%) at low temperature is found for Fe doped samples.

25CP96 Anisotropic exchange parameters in CuGeO3, deduced from EPR spectra

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A systematic revision of the angular dependence of the EPR spectra has been performed at temperatures 10-60K in (ab), (ac) and (bc) planes. The dominating part of the exchange anisotropy is attributed to the ring-exchange interaction within the chains. Relative values of anisotropic exchange parameters are extracted. Our analysis is consistent with the crystal-structure data. In addition the evidence of domain walls due to non-dimerized spins along the b axis, below the spin-Peierls transition, will be presented.

25CP97 The photoluminescence investigation of $Zn_xMn_{1-x}Te$ films

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We have measured photoluminescence spectra of $Zn_xMn_{1-x}Te$ films placed on a GaAs substrate with ZnSe buffer layer by the low temperature (10 K). These spectra were taken with the use of an Ar ion laser excitation (=488.8nm). The value x equals 0, 0.04, 0.11, 0.152, 0.18 and 0.26. For the pure ZnTe we observed the well-resolved some (five) exciton lines that can be attributed to free and bound excitons. The integral (total) intensity of photoluminescence lines for the sample with $x = 0.04$ approximately in five time bigger than for the sample ZnTe: the photoluminescence for the samples contained Mn is caused by excitons bounded on Mn. With the increasing of the Mn the line width of the main peak increases essentially. For the pure ZnTe film the FWHL is 2.5 meV about, for the $Zn_{0.74}Mn_{0.26}Te$ film the one is 25 meV. The essential increasing of the line width indicates an increase of an inhomogeneous structure.

25CP98 Photo-Induced Transient Thermoelectric Effect in Ferromagnetic $BaIrO_3$

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$BaIrO_3$ undergoes a unique CDW transition accompanied by ferromagnetic orderingis. We have performed photo-induced transient thermoelectric effect experiments and then observed that the TTE singals show highly anisotropy. We have found that the magnitude of the signals changes drastically at the Curie temperature. By taking account of the band calculations, we propose a tentative model for the nested Fermi surfaces.