1B/2003G027

# Pressure Effects on Single Chain Magnets with $Mn^{I}$-$Ni^{II}$- $Mn^{III}$unit

M. Mito*[1, 2], T. Tajiri[1], H. Deguchi[1,2], S. Takagi[1], H. Miyasaka[2,3,4], M. Yamashita[2,3]
[1]Faculty of Engineering, Kyushu Institute of Technology, Kitakyushu 804-8550, Japan
[2]CREST, Japan Science and Technology Agency (JST), Saitama 332-0012, Japan
[3]Department of Chemistry, Tokyo Metropolitan University, Tokyo 192-0397, Japan
[4] PRESTO, Japan Science and Technology Agency (JST), Saitama 332-0012, Japan

## Introduction

$[Mn_2(saltmen)_2Ni(pao)_2(L)_2](A)_2$ (L: intrachain moiety, A: interchain one) series have attracted much attention as a single chain magnet (SCM) [1-3]. This one-dimensional material with the repeating unit of [-$Mn^{III}$-ON-$Ni^{II}$-NO-$Mn^{III}$-$(O)_2$-] can be treated with an $S = 3$ (= +2 -1 +2) Ising ferromagnetic chain model at low temperatures, due to the antiferromagnetic interaction $J_{Mn\text{-}Ni}$ of -20 K and ferromagnetic $J_{Mn\text{-}Mn}$ of +1 K. Furthermore the Jahn-Teller distortion around $Mn^{III}$ ion brings about negative single-ion anisotropy ($D$) along the chain. As a result, the energy barrier ($\Delta$) for spin-reversal is realized due to these factors. The magnetization relaxes with a finite relaxation time ($\tau$), which can reach years.

The strategy in this study of pressure experiment is to enhance the characteristic of SCM effectively by controlling the crystal structure using external stress [4].

## Experiment

Ac magnetic susceptibilities in the frequency region of 1-500 Hz were measured for three compounds as (1) L = pyridine (py), $A^- = ClO_4^-$, (2) L = py, $A^- = ReO_4^-$, and (3) L = *N*-methylimidazole, $A^- = ClO_4^-$ in the pressure region up to 13 kbar. The SR powder structural analysis experiments at room temperature were carried out in the pressure region up to 20 kbar at the beamline 1B.

## Results and Discussion

A blocking temperature ($T_B$) is defined as the temperature with the peak of out-of-phase susceptibility. From the slope of the Arrhénius plot for the frequency dependence of $T_B$, the value of $\Delta$ is estimated, and the pressure dependence is shown in Fig.1. In all materials, the increase of $\Delta$ by applying pressure is observed. The pressure effects on $\Delta$depend on the kind of intrachain moiety L, that is, chain structure.

The changes of shrinkage ratio for the principle crystal axes and volume up to $P$ = 20 kbar are shown in Fig.2. The chain of SCM runs along [101] direction. For (1) and (2), the pressure-induced enhancement of $\Delta$ saturates at around 10 kbar, and these chains shrink not isotropically but distoring. In the case of (3), however, $\Delta$ continues to increase in the considered pressure region, and the chain shrinks isotropically. We attach great importance to the change of $D$ rather than those of $J_{Mn\text{-}Ni}$ and $J_{Mn\text{-}Mn}$ for these pressure effects on $\Delta$. The detailed discussion needs the information about positions of metal ions and oxygen atoms around Mn ion using the Rietveld analysis.

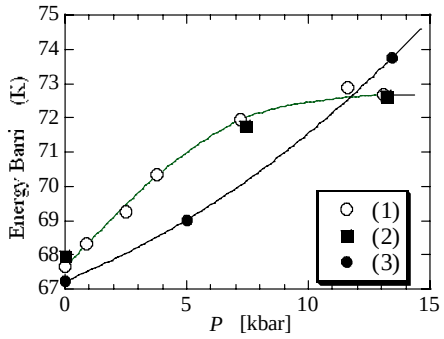


Fig.1. Pressure dependence of energy barrier$\Delta$.

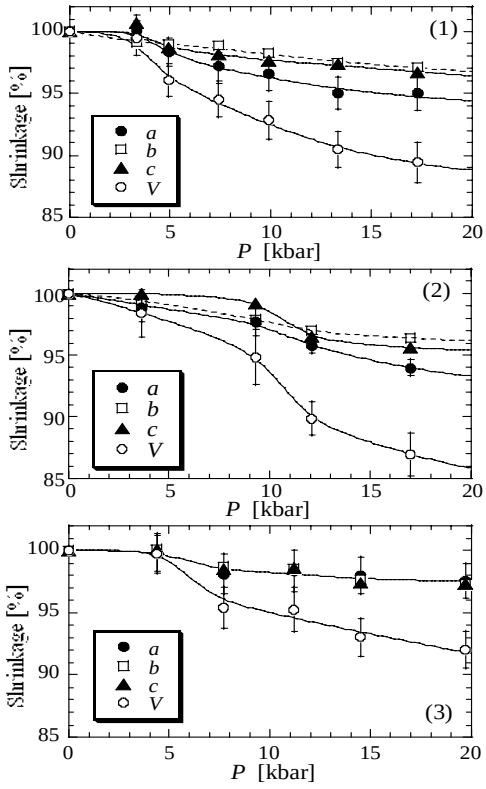


Fig.2. Shrinkage ratio of the principle axes and volume.

## References

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* mitoh@elcs.kyutech.ac.jp