

## Pressure Effects on the Magnetism and Structure of an Organic Radical Ferromagnet: 2,5-Difluorophenyl- $\alpha$ -Nitronyl Nitroxide

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### Introduction

The ferromagnetic transition temperature ( $T_c$ ) of organic radical ferromagnets has not exceeded even 1.5 K yet. Our attempt is to increase  $T_c$  artificially by applying hydrostatic pressure in several prototype of compounds [1-4]. In most cases, the ferromagnetic state transits into the antiferromagnetic one at around  $P = 6 - 7$  kbar [1,2,4]. Only in 2,5-difluorophenyl- $\alpha$ -nitronyl nitroxide (abbreviated as 2,5-DFPNN),  $T_c$  is enhanced by pressurization [3].

We report pressure effects on the magnetism and structure of 2,5-DFPNN up to 10 GPa, and discuss the mechanism on the pressure-induced enhancement of  $T_c$  [5].

### Experiment

The polycrystalline sample of 2,5-DFPNN was synthesized according to the procedure mentioned in Ref. 6. The  $T_c$  at ambient pressure is 0.45 K [6]. The magnetic susceptibility under pressure up to 10 GPa was measured in the temperature region from 0.3 to 1.5 K. The SR powder structural analysis experiment at room temperature was carried out in the pressure region up to 4.7 GPa at the beamline 1B.

### Results and Discussion

The pressure dependence of magnetic susceptibility of 2,5-DFPNN up to 3.9 GPa is shown in Fig.1. The huge anomaly due to the ferromagnetic ordering shifts toward high temperatures with increasing pressure, reducing the magnitude. At  $P = 3.9$  GPa,  $T_c$  reaches up to around 0.7 K. As for  $P \geq 5$  GPa, the ferromagnetic signal has not been observed, and the ferromagnetic ordered state becomes unstable with increasing pressure.

The shrinkage ratios of the principle crystal axes and volume up to  $P = 4.7$  GPa are shown in Fig.2. This substance originally has a stacking structure of the ferromagnetic  $ab$ -plane. Figure 2 shows the interplane shrinkage is more remarkable than the intraplane one. Given the above result of magnetic susceptibility, it is assumed that the ferromagnetic interplane network may be destroyed accompanying the slight change of the intramolecule structure. The instability of bulk-ferromagnetic state against the external stress may be a common characteristic for *soft* organic radical crystals.

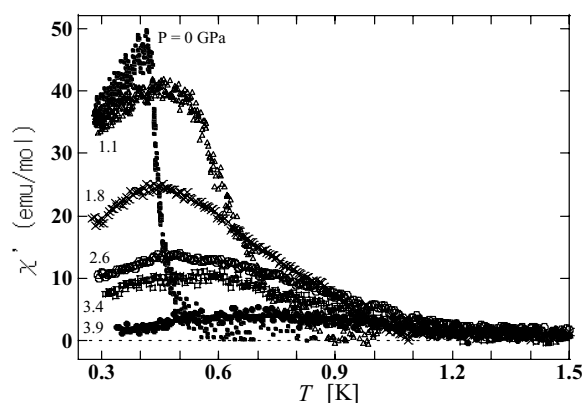


Fig.1. Pressure dependence of magnetic susceptibility of 2,5-DFPNN up to  $P = 3.9$  GPa.

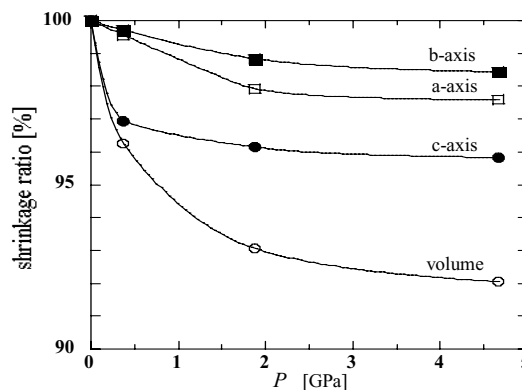


Fig.2. Shrinkage ratios of the principle crystal axes and volume up to  $P = 4.7$  GPa.

### References

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