Supporting Information (Online Material) for

Ferrimagnetic and relaxor ferroelectric properties of $R_2MnMn(MnTi_3)O_{12}$ perovskites with R = Nd, Eu, and Gd

Ran Liu,[a,b] Masahiko Tanaka,[c] Hiromu Mori,[d] Yoshiyuki Inaguma,[d] Kazunari Yamaura[a,b] and Alexei A. Belik[*a]

[a] *International Center for Materials Nanoarchitectonics (WPI-MANA), National Institute for Materials Science (NIMS), Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan. E-mail: Alexei.Belik@nims.go.jp*

[b] *Graduate School of Chemical Sciences and Engineering, Hokkaido University, North 10 West 8, Kita-ku, Sapporo, Hokkaido 060-0810, Japan*

[c] *Synchrotron X-ray Station at SPring-8, NIMS, Kouto 1-1-1, Sayo-cho, Hyogo 679-5148, Japan*

[d] *Department of Chemistry, Faculty of Science, Gakushuin University, 1-5-1 Mejiro, Toshima-ku, Tokyo 171-8588, Japan*

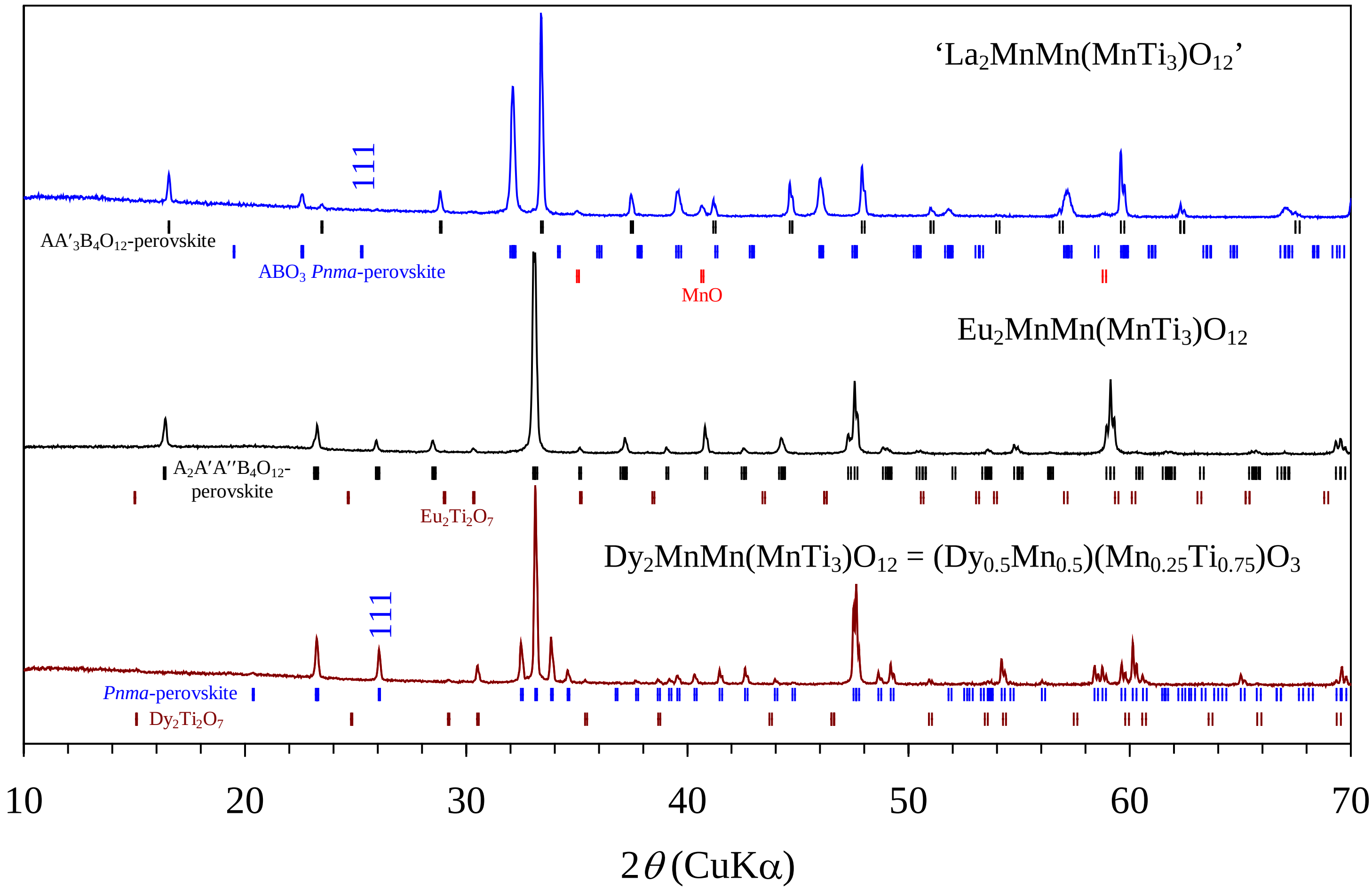

Fig. S1. Laboratory powder X-ray diffraction patterns at room temperature for (upper) a sample with the total chemical composition of $La_2MnMn(MnTi_3)O_{12}$, (middle) $Eu_2MnMn(MnTi_3)O_{12}$ and (bottom) $Dy_2MnMn(MnTi_3)O_{12}$. Tick marks show possible Bragg reflection positions for phases indicated on the figure.
Note the ABO_3-type phase in $La_2MnMn(MnTi_3)O_{12}$ was described by the $GdFeO_3$ *Pnma* model. However, because of the absence of the (111) peak, which is usually observed in the $GdFeO_3$ *Pnma* model, the real symmetry of the ABO_3-type phase might be different.

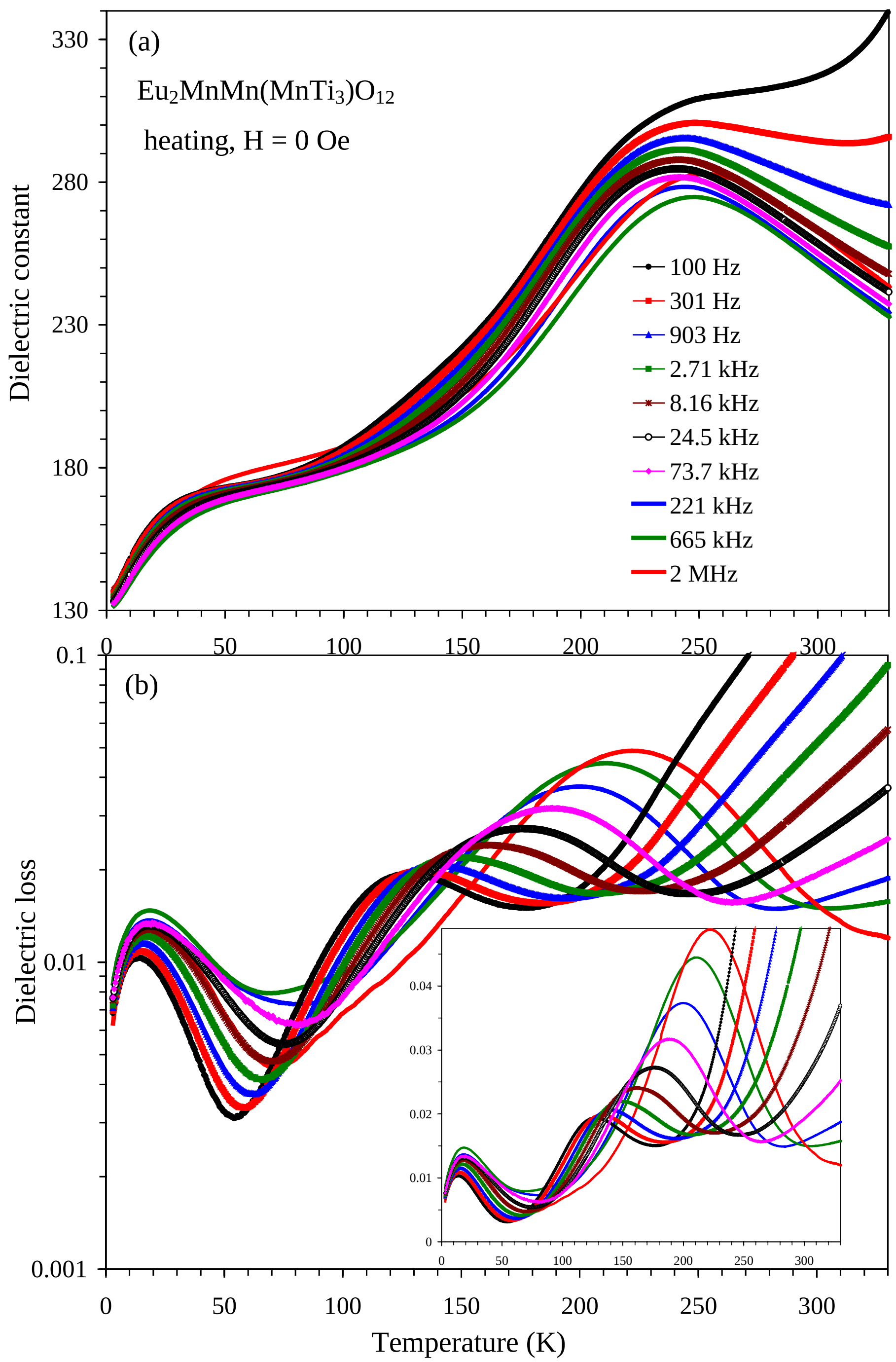

Fig. S2. (a) Frequency-dependent (f = 100 Hz - 2 MHz) dielectric constant of $Eu_2MnMn(MnTi_3)O_{12}$ as a function of temperature measured at H = 0 Oe on heating. (b) The corresponding frequency-dependent dielectric loss of $Eu_2MnMn(MnTi_3)O_{12}$, plotted in the logarithmic scale. Inset gives the same dielectric loss in the linear scale.

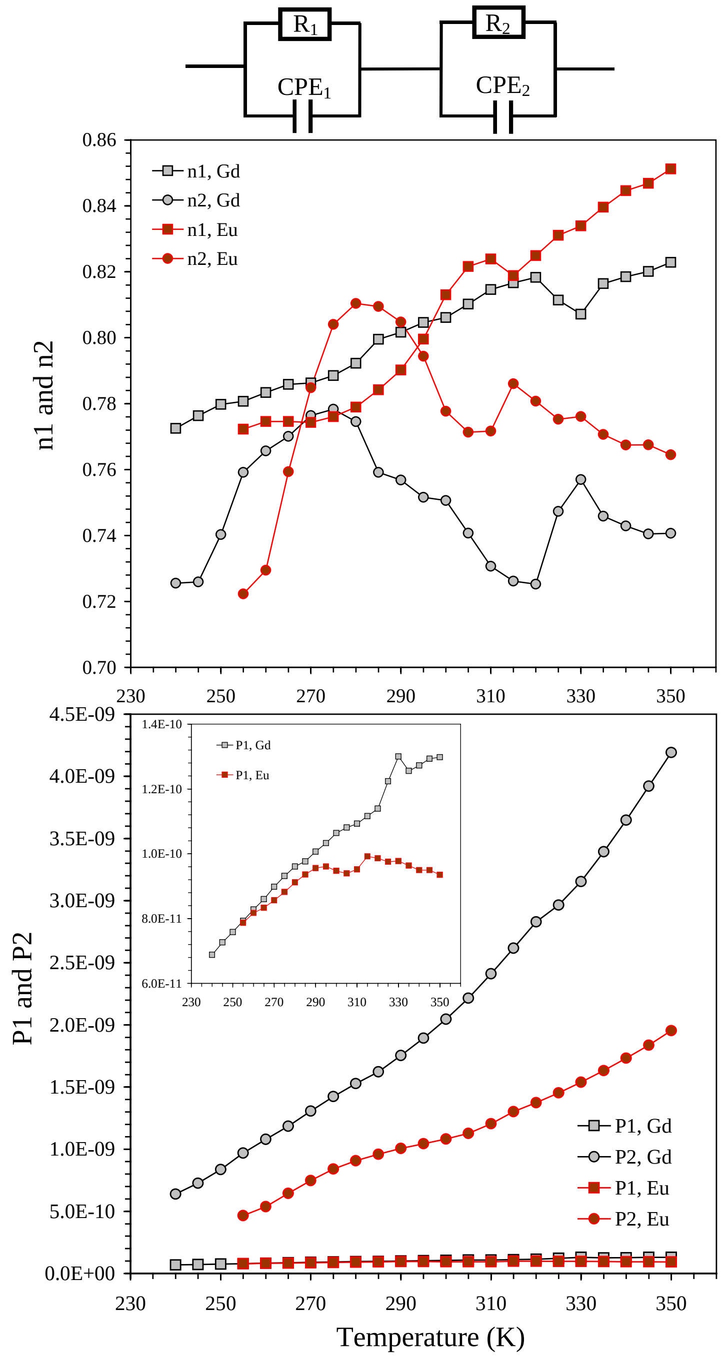

Fig. S3. Temperature dependence of the fitting parameters for constant phase elements obtained from the impedance measurements for $Eu_2MnMn(MnTi_3)O_{12}$ and $Gd_2MnMn(MnTi_3)O_{12}$. The equivalent circuit used for the fittings is shown on the top. R: a resistor, CPE: a constant phase element.

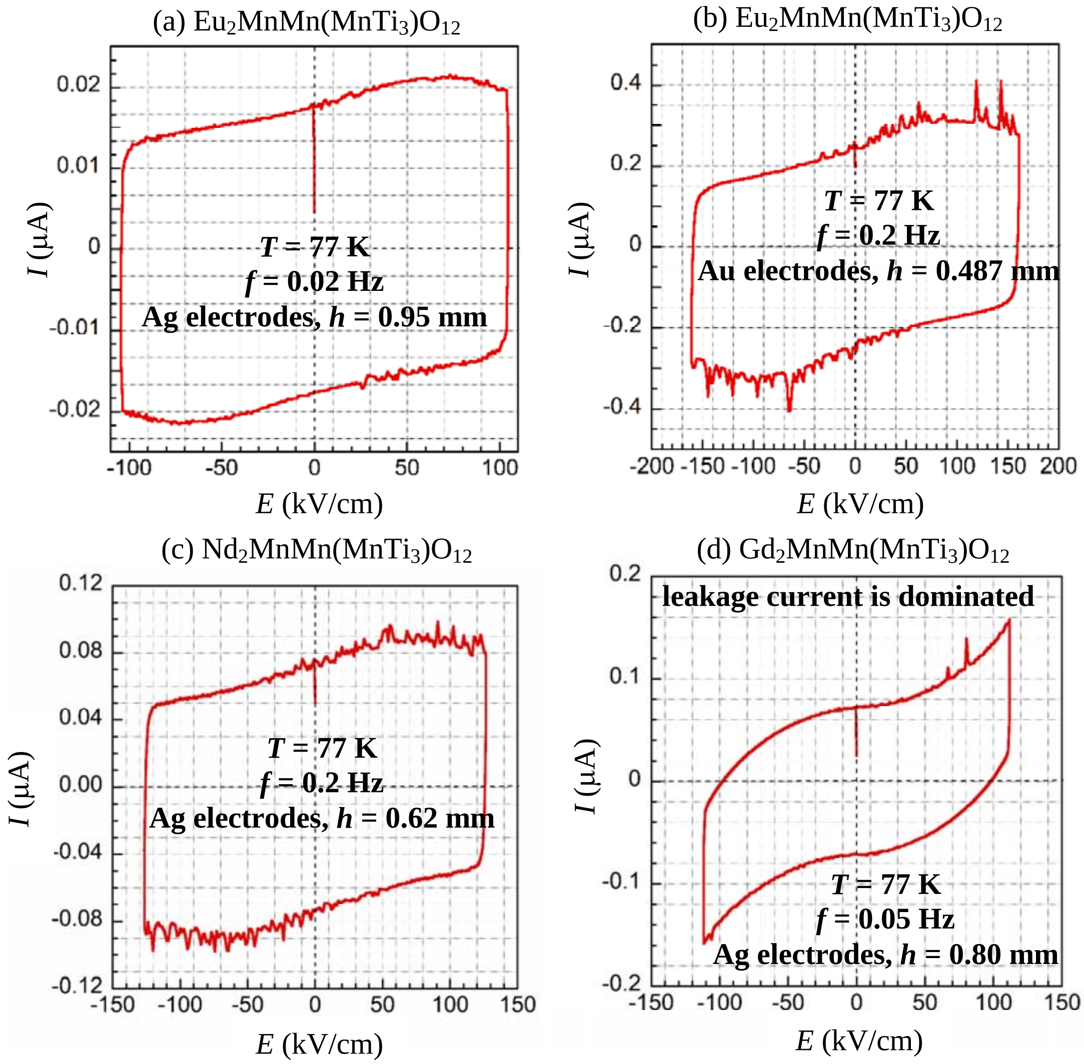

Fig. S4. *I*-*E* hysteresis loops at T = 77 K for (a, b) $Eu_2MnMn(MnTi_3)O_{12}$, (c) $Nd_2MnMn(MnTi_3)O_{12}$ and (d) $Gd_2MnMn(MnTi_3)O_{12}$. Measurement frequencies, electrode materials and sample thickness are given on figures.