Electronic Supplementary Information

Completing the triad: synthesis, structure, and magnetic properties of kagome metals $Ti_3Mn_3Sn_4Ga$ and $Hf_3Mn_3Sn_4Ga$

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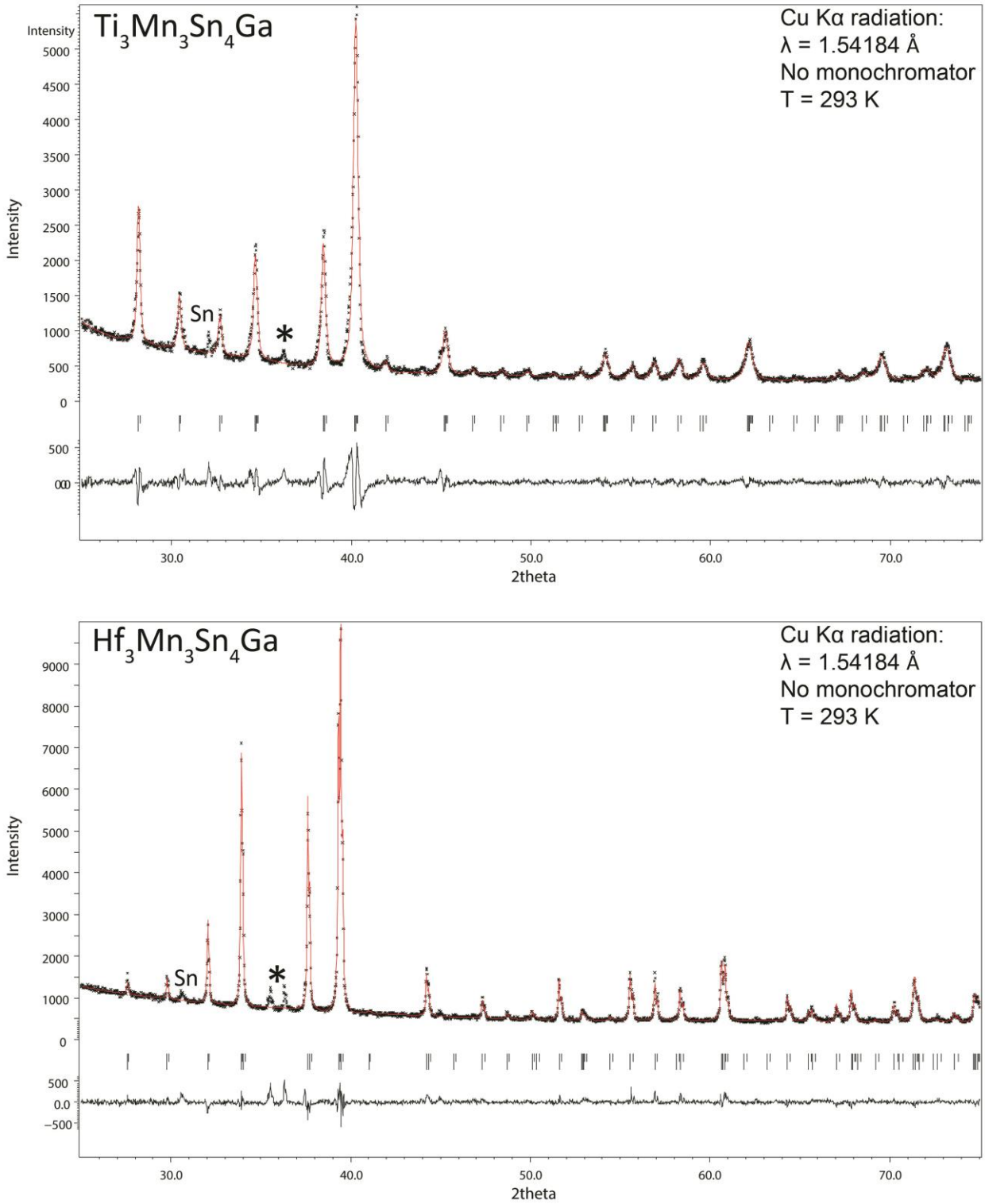

Fig. S1. Powder X-ray diffraction pattern of the ground $Ti_3Mn_3Sn_4Ga$ (upper) and $Hf_3Mn_3Sn_4Ga$ (lower) crystals. For each pattern, the upper black dots represent the experimental diffraction pattern and the red line shows the calculated pattern obtained from a le Bail fit. Peak positions are given by the ticks. The difference plot is shown by the black line in the bottom part. The diffraction peaks of unidentified phases are marked with asterisks.

Table S1. Literature data for the interatomic distances between Ti, Hf, Mn, Sn, and Ga atoms in similar intermetallic phases

atom	atom	range of distances, Å	phase	reference
Ti	Mn	2.77	$TiMnSn_4$	[1]
		2.84	$TiMn_2$	[2]
		2.90-3.01	$TiMnSi_2$	[3]
Hf	Mn	2.91	$HfMn_2$	[4]
		3.26	$HfMn_6Ge_6$	[5]
		3.5	$HfMn_6Sn_6$	[6]
Ti	Sn	2.77-3.36	α-Ti_6Sn_5	[7]
		2.84-2.88	$TiMnSn_4$	[1]
		3.07-3.28	Ti_2Sn_3	[8]
Hf	Sn	2.91-3.16	$HfMn_6Sn_6$	[6]
		2.92-3.24	Hf_5Sn_3	[9]
Ti	Ga	2.64-2.90	Ti_2Ga_3	[10]
		2.66-2.82	Ti_5Ga_4	[10]
		2.68-2.89	$TiGa_3$	[10]
Hf	Ga	2.68-3.15	Hf_2Ga_3	[10]
		2.69-3.28	$Hf_{11}Ga_{10}$	[10]
		2.74-2.98	$HfGa_3$	[10]
		2.76-2.98	$HfGa_2$	[10]
Mn	Sn	2.60-3.10	Mn_3Sn_2	[11]
		2.70-2.82	$HfMn_6Sn_6$	[6]
		2.83-2.88	Ti_2Sn_3	[8]
		2.84	$MnSn_2$	[12]
Ti	Ti	2.73-3.55	Ti_5Ga_4	[10]
		2.75-3.88	α-Ti_6Sn_5	[7]
		2.95	$TiMn_2$	[2]
		2.96	Ti_2Ga_3	[10]
		3.07-3.28	Ti_2Sn_3	[8]
Hf	Hf	2.91-3.62	Hf_5Sn_3	[9]
		3.13-3.70	$Hf_{11}Ga_{10}$	[10]
		3.29	$HfGa_2$	[10]

		3.34-3.36	Hf_2Ga_3	[10]
Mn	Mn	2.34-2.50	$TiMn_2$	[2]
		2.57	$HfMn_6Ge_6$	[5]
		2.70-2.84	Mn_3Sn_2	[11]
		2.71	$MnSn_2$	[12]
Sn	Sn	3.15-3.52	$HfMn_6Sn_6$	[6]
		3.03-3.52	$MnSn_2$	[12]
		3.27	Mn_3Sn_2	[11]
		3.36	Hf_5Sn_3	[9]
		2.85-3.58	α-Ti_6Sn_5	[7]
		3.21-3.66	Ti_2Sn_3	[8]
Ga	Ga	2.48-2.76	Hf_2Ga_3	[10]
		2.51-3.24	$Hf_{11}Ga_{10}$	[10]
		2.68-2.89	$TiGa_3$	[10]
		2.71-2.95	Ti_2Ga_3	[10]
		2.73-3.32	Ti_5Ga_4	[10]
		2.74-2.98	$HfGa_3$	[10]
		2.83-2.98	$HfGa_2$	[10]

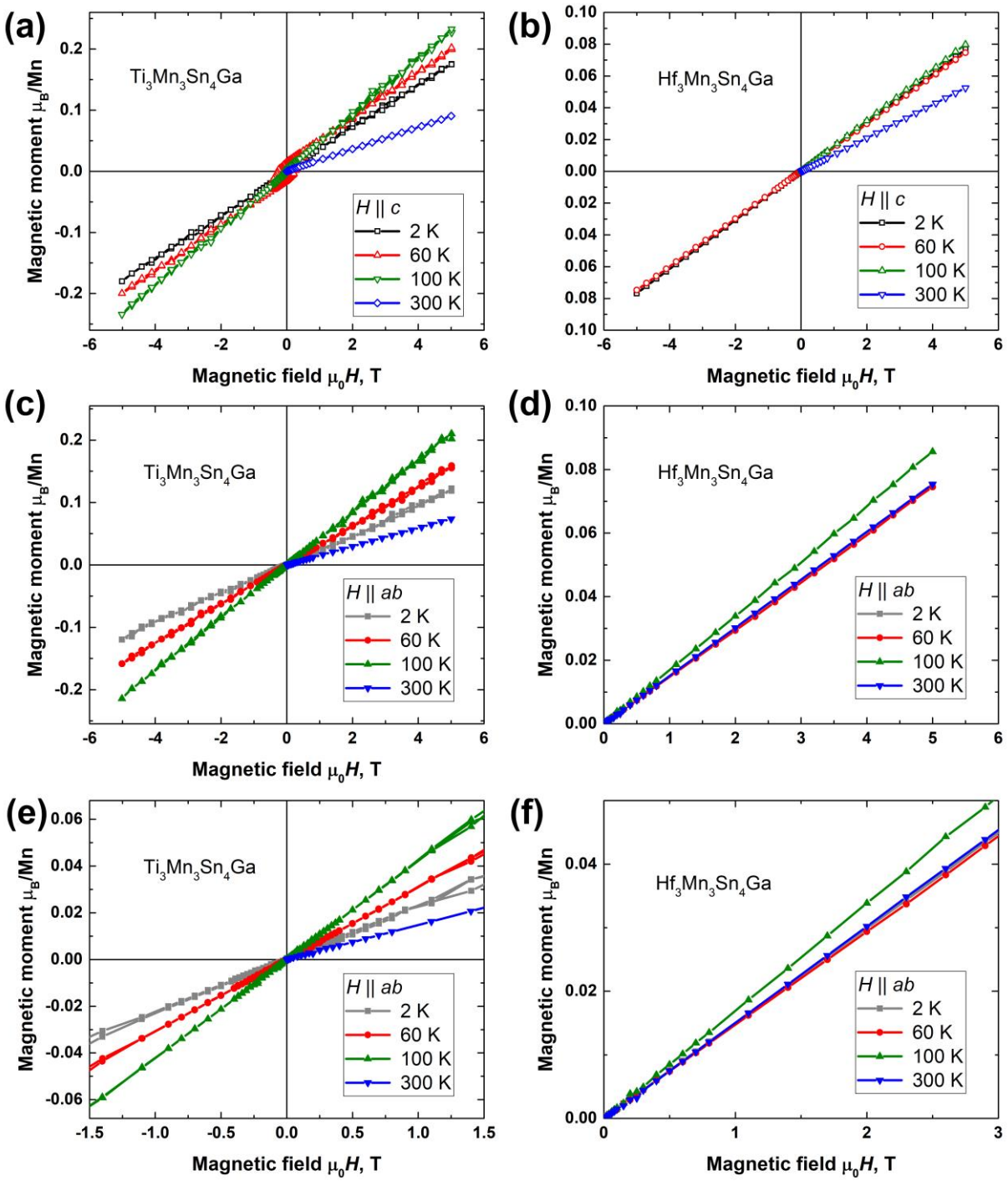

Fig. S2. Field dependence of magnetisation of $Ti_3Mn_3Sn_4Ga$ (a, c, e) and $Hf_3Mn_3Sn_4Ga$ (b, d, f) single crystals for different temperatures and orientations of magnetic field.

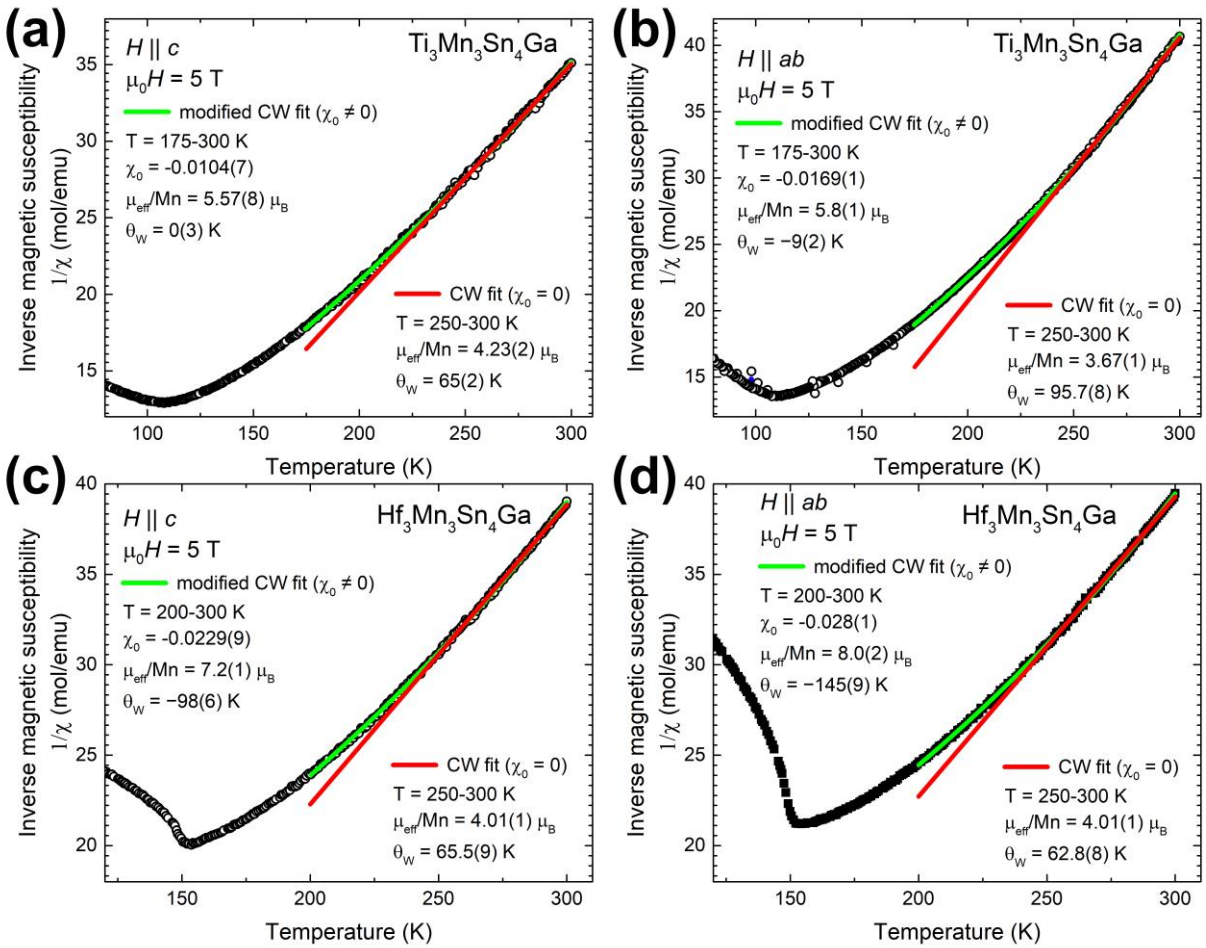

Fig. S3. Inverse magnetic susceptibility versus temperature of $Ti_3Mn_3Sn_4Ga$ (a, b) and $Hf_3Mn_3Sn_4Ga$ (c, d) single crystals in various magnetic fields. Black dots and lines represent the experimental data; red and green lines show the non-modified and modified Curie-Weiss fits, respectively. The modified Curie-Weiss fit was performed using the modified Curie-Weiss law: $\chi = C/(T - \theta_W) + \chi_0$, where C is the Curie constant, θ_W is the Weiss temperature, and χ_0 is the temperature independent contribution to the susceptibility, while for the non-modified Curie-Weiss fit χ_0 was fixed at 0. The temperature ranges used for the Curie-Weiss approximations and the refined Curie-Weiss parameters are shown by the respective graphs. The effective moment per Fe atom μ_{eff}/Mn was calculated as $\mu_{eff}/Mn = \sqrt{\frac{3k_B C}{n_{Mn} N_A \mu_B}}$, where n_{Mn} = 3 is the number of Mn atoms in the formula unit, k_B is the Boltzmann constant, N_A is the Avogadro number, and μ_B is the Bohr magneton.

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