



Magnetic and Electric Properties of AISI 430 Ferritic Stainless Steels

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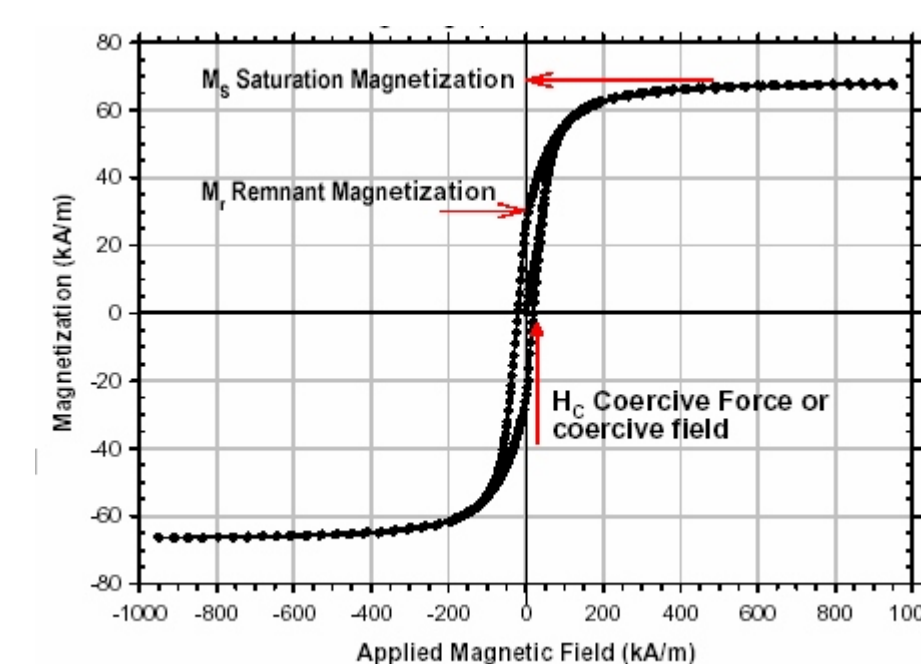
Ferritic steel AISI 430 is a candidate material for the ITER vacuum vessel which will be used to limit the ripple in the toroidal magnetic field. The magnetic and electric properties and their temperature dependence of AISI 430 ferritic stainless steels (SS) are presented.

X-Ray Fluorescence and chemical analysis measurements were used to determine the Cr, Mn, Fe, O, N, C and S concentration.

Element	Carpenter SS AISI 430 FR (wt%)		Allegheny SS AISI 430 (wt%)	
	nominal	measured	nominal	measured
C	0.06 (max.)	0.014	0.12 (max.)	0.0745
N		0.023		0.043
O		110 ppm		110 ppm
Mn	0.80 (max.)		1.00 (max.)	0.75 ± 0.07
P	0.030 (max.)		0.040 (max.)	
S	0.250 to 0.400 (max.)	0.34	0.030 (max.)	0.003
Si	1.00 to 1.50 (max.)		1.00 (max.)	
Cr	17.25 to 18.25	17.3 ± 0.7	16.00 to 18.00	17.45 ± 0.30
Ni	0.60 (max.)		-	
Mo	0.50 (max.)		-	
Iron	Balance		Balance	80.87 ± 0.70

The nominal and measured chemical composition of the two types of stainless steel materials used for the measurements.

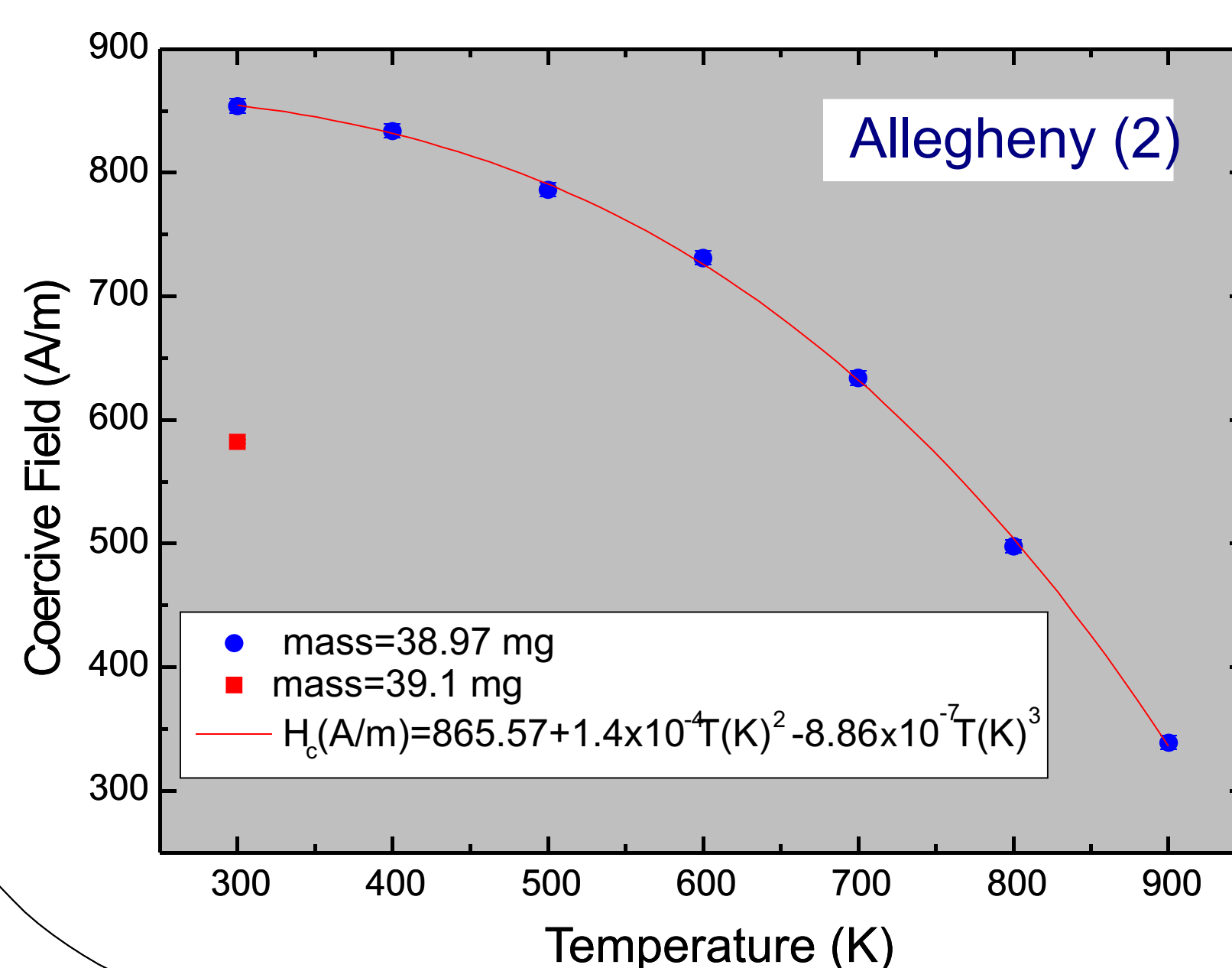
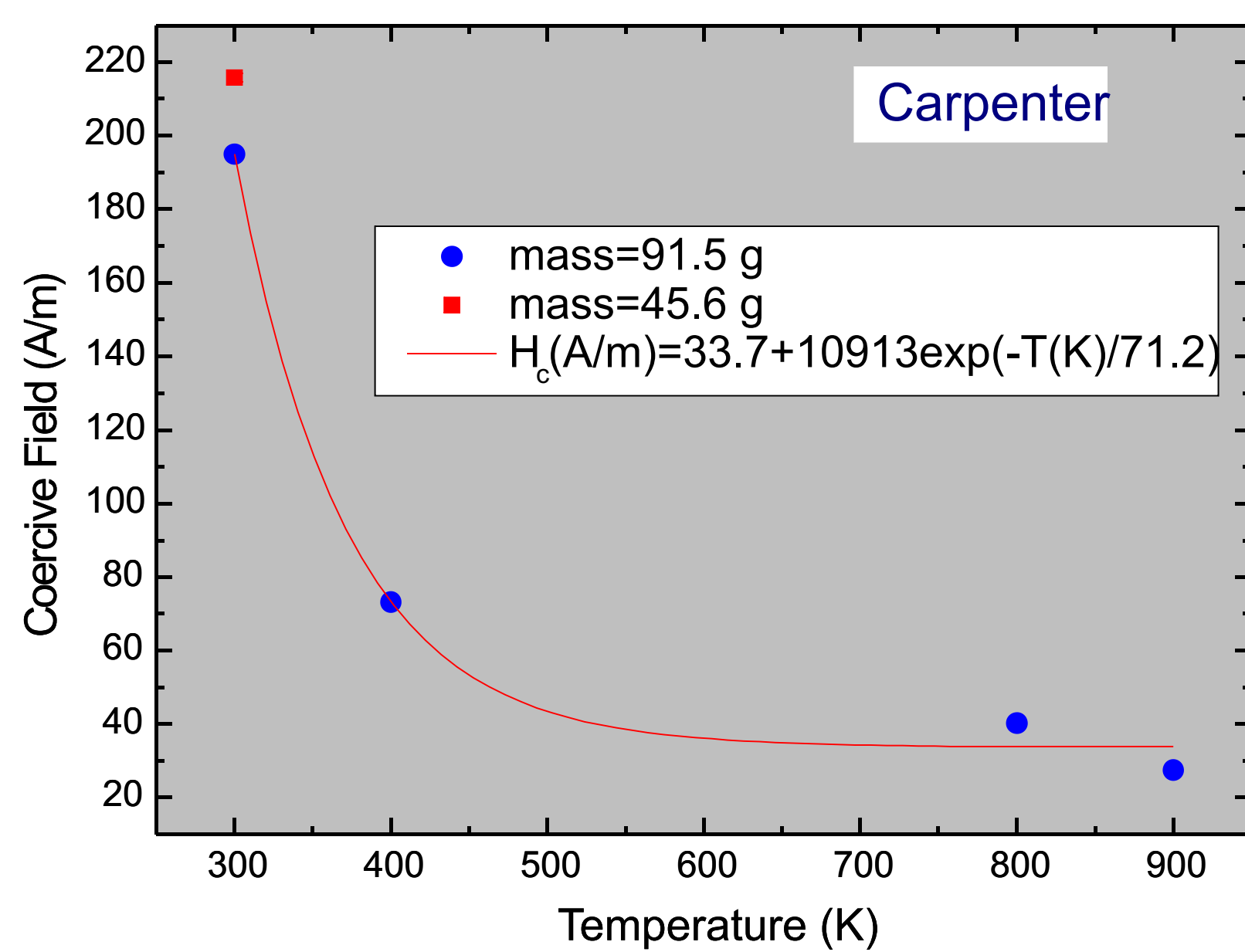
✓ Magnetic loop measurements were performed in the temperature range 290 to 900 K using a Vibrating Sample Magnetometer. From the loops the coercive field, the remanence and saturation magnetization were determined.



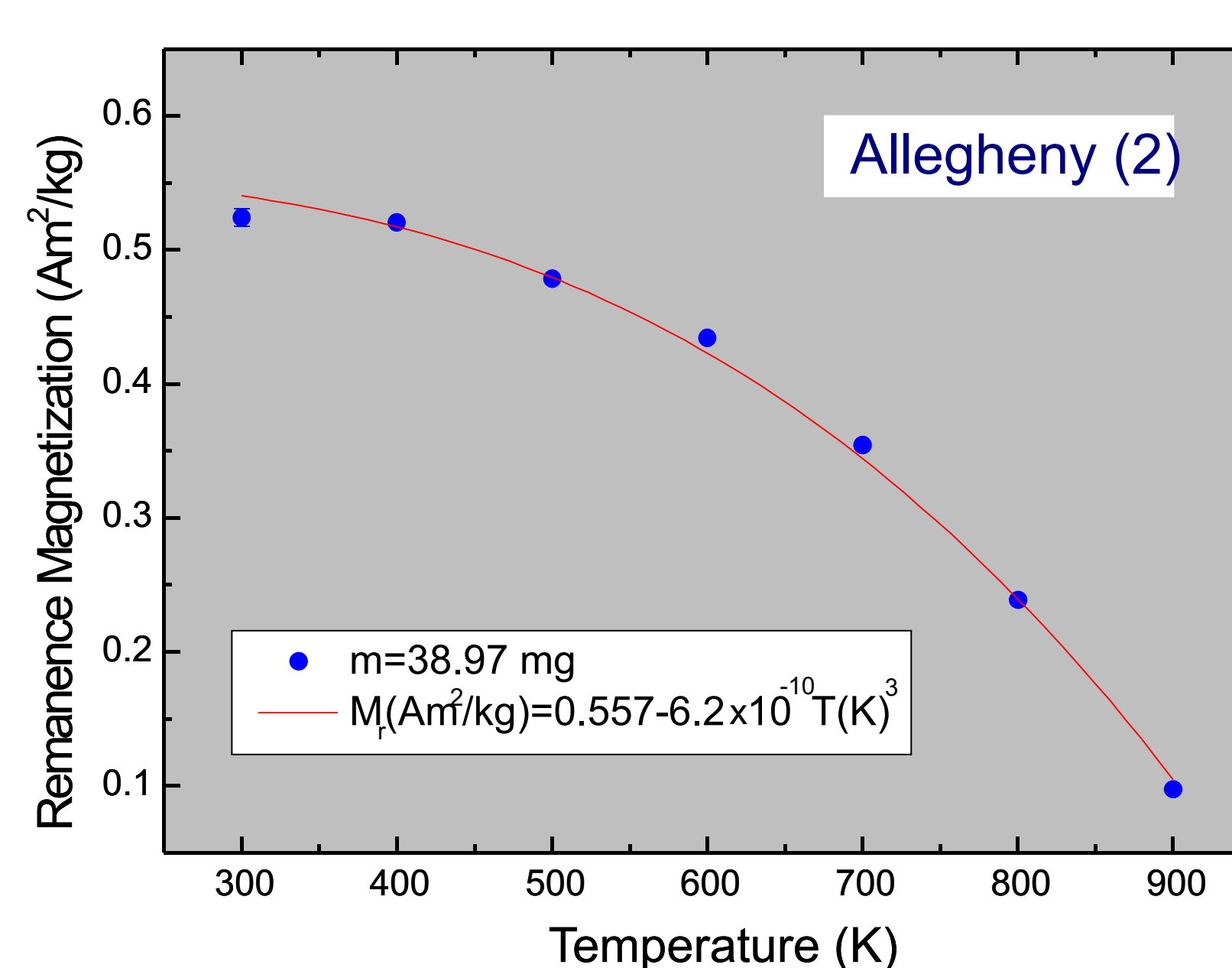
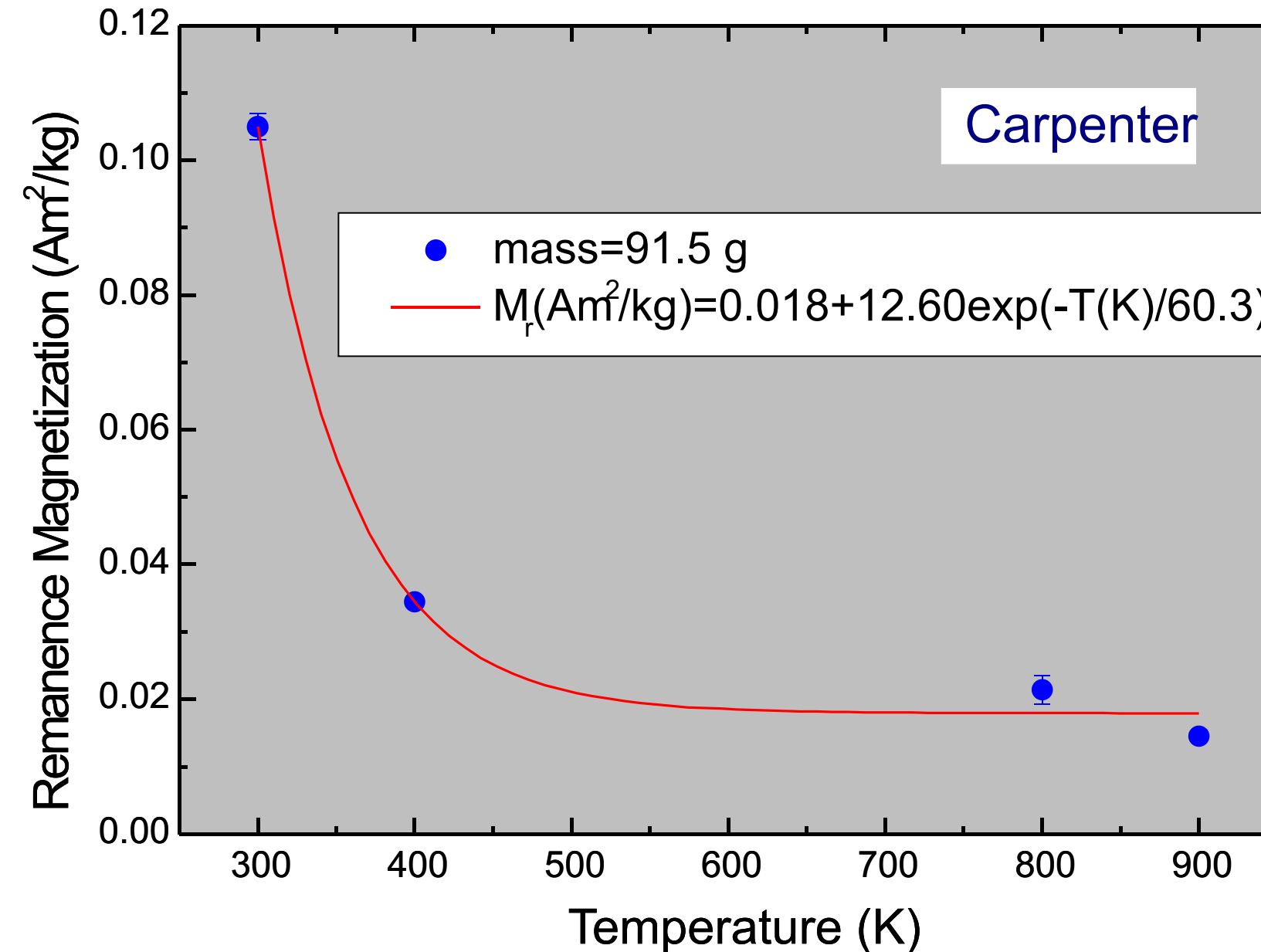
- ✓ Calibration of the magnetization values was performed using Standard Reference Materials.
- ✓ Annealing of the samples at 200 ° C for one week has no effect on their magnetic properties.
- ✓ Carpenter SS present much lower coercive fields and remanence magnetization than Allegheny SS, but saturation magnetizations are similar.
- ✓ The magnetic transition temperature for both SS is about $T_c=965$ K

Temperature variation of the magnetic properties

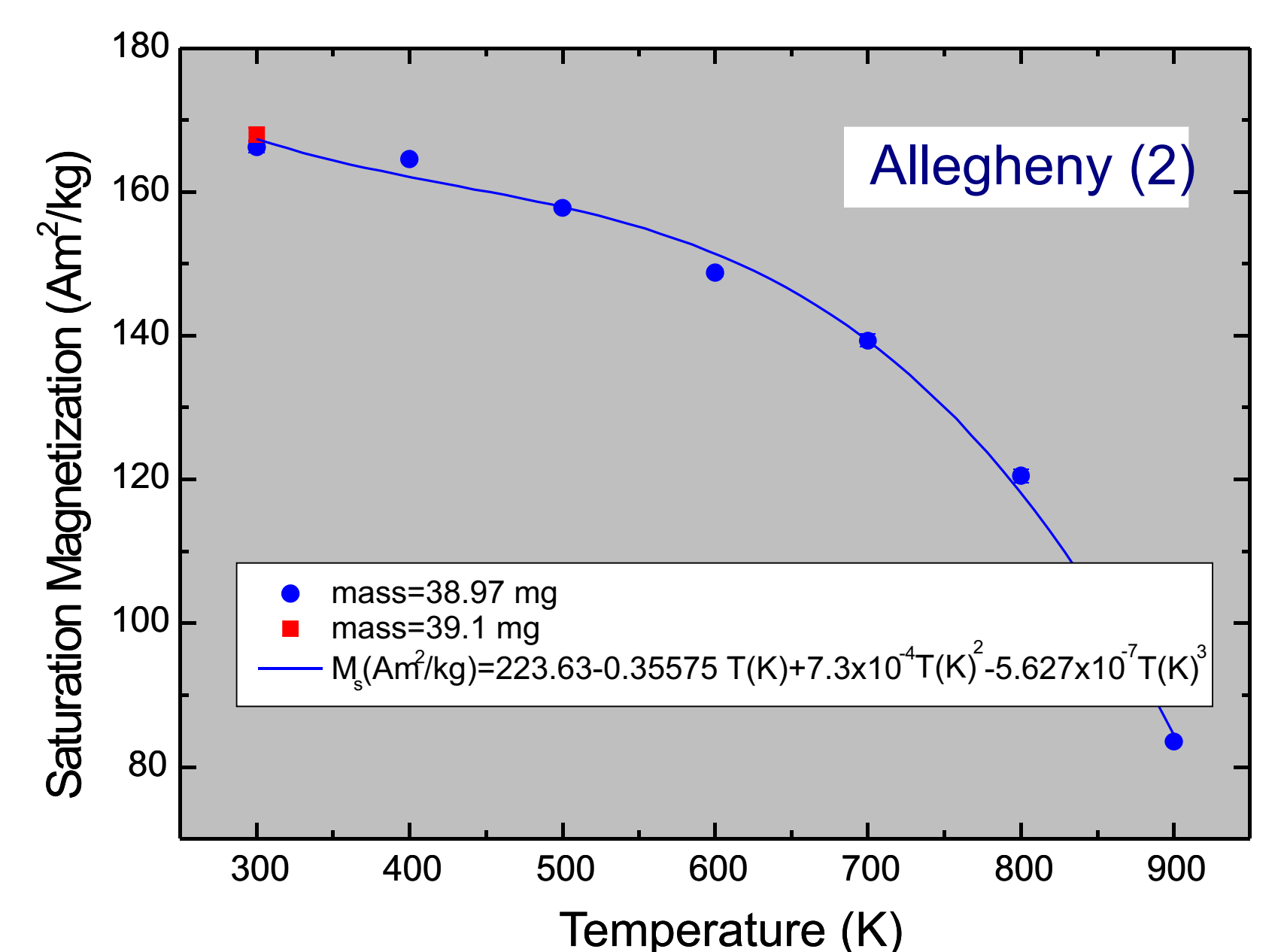
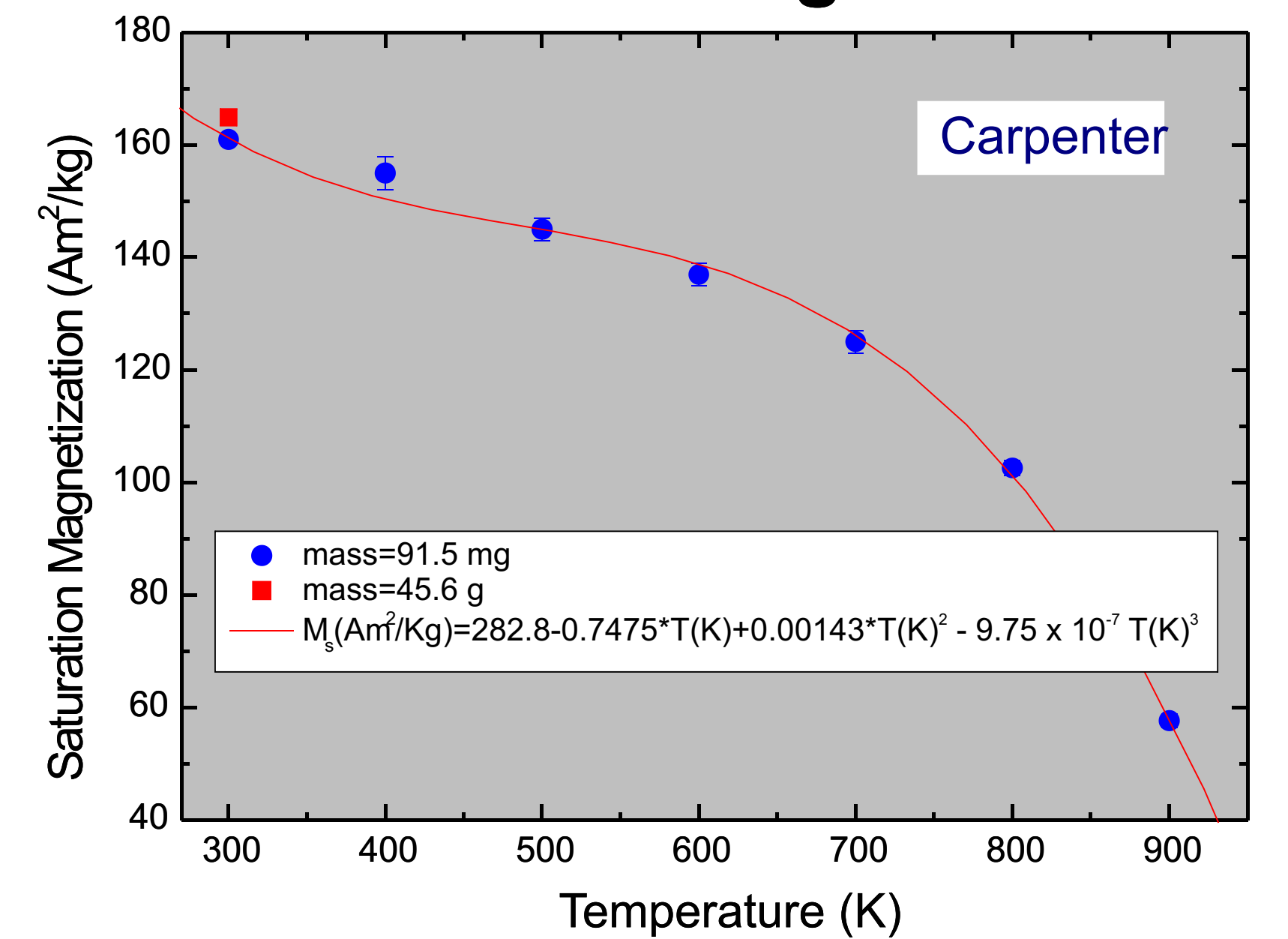
Coercive field



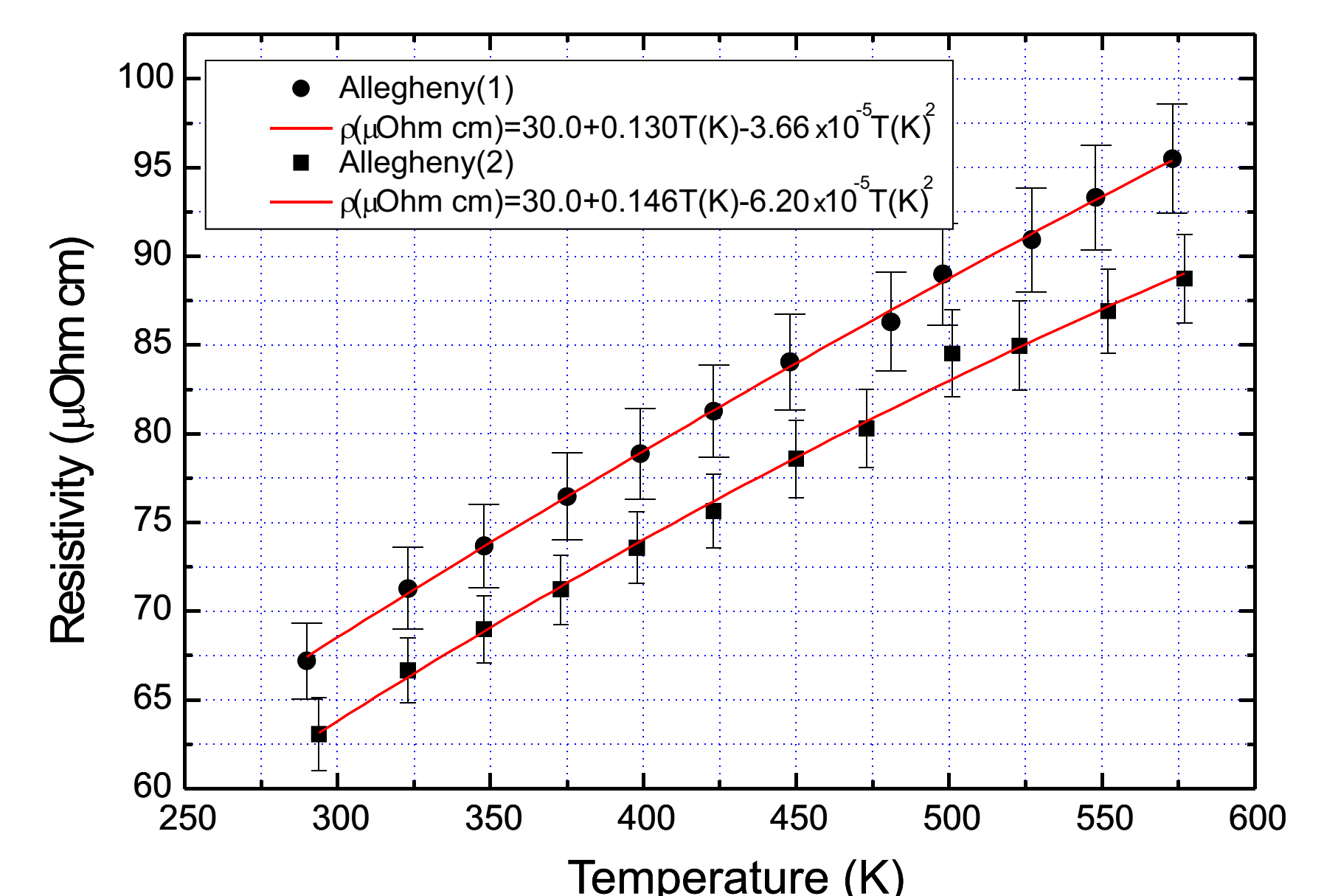
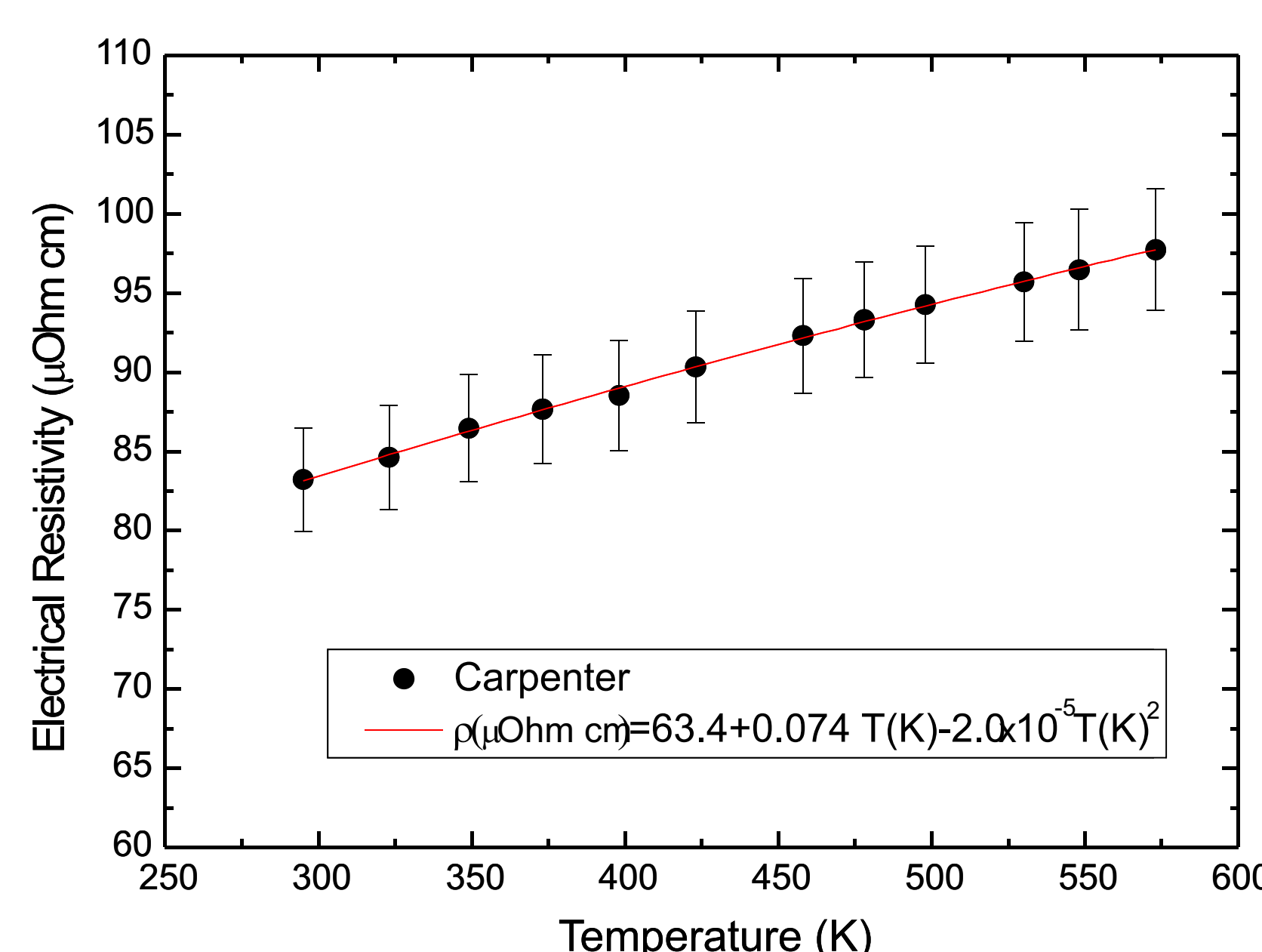
Remanence Magnetization



Saturation Magnetization



The electrical resistivity versus temperature shows increased resistivity rate for Allegheny SS in comparison to Carpenter SS.



Electrical resistivity versus temperature