Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

SUPPORTING INFORMATION
Synthesis of highly ordered $L1_0$ MPt alloys (M=Fe, Co, Ni) from crystalline salts: an in-situ study of the Pre-Ordered Precursor Reduction strategy

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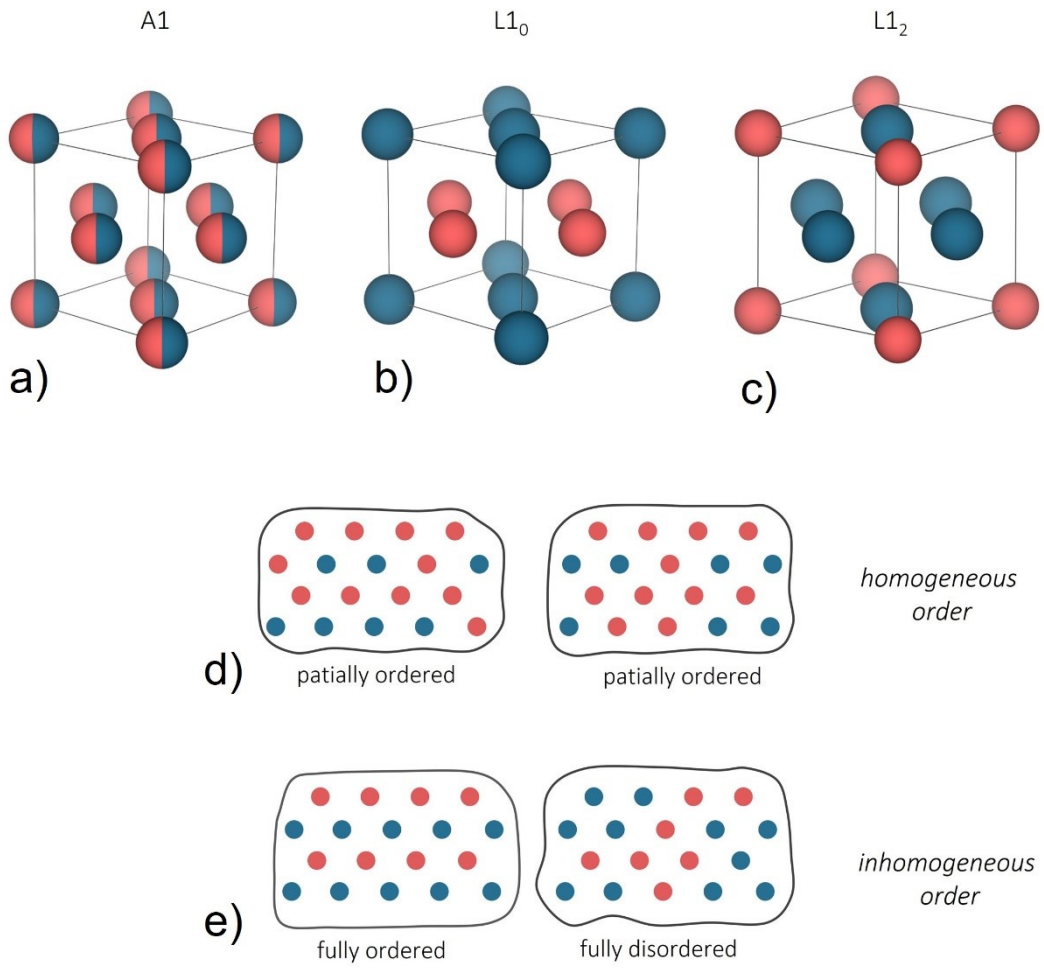
Figure S1. (a-c) Sketchs of the disordered (50:50, A1) and ordered (50:50 $L1_0$, 25:75 $L1_2$) crystallographic phases of the MPt (M = Fe, Co, Ni) alloys. (d-e) Differences in homogeneous and inhomogeneous partial order in a granular MPt (50:50) system. In a homogeneous system, each grain is characterized by a $L1_0$ arrangement with a certain amount of atoms in a wrong position (partial order); in a inhomogeneous system, some grains are fully ordered and some grains are fully disordered. In the present study we assume that the PPR process produces homogeneous FePt and CoPt and inhomogeneous NiPt alloys. [1]



[1] *A. Cebollada, R.F.C. Farrow, M.F. Toney, Structure and magnetic properties of chemically ordered magnetic binary alloys in thin film form, in: H.S. Nalwa (Ed.), Magn. Nanostructures, American Scientific Publishers, 2002, p. 93.*

Figure S2. Comparison between data acquired at the Pt-L_{III} (left) and Fe-K (right) edge on the $L1_0$ FePt final alloy synthetized with the PPR process in the home furnace (@lab) and in the EXAFS chamber (@LISA). The comparison shows the high reproducibility of the process.

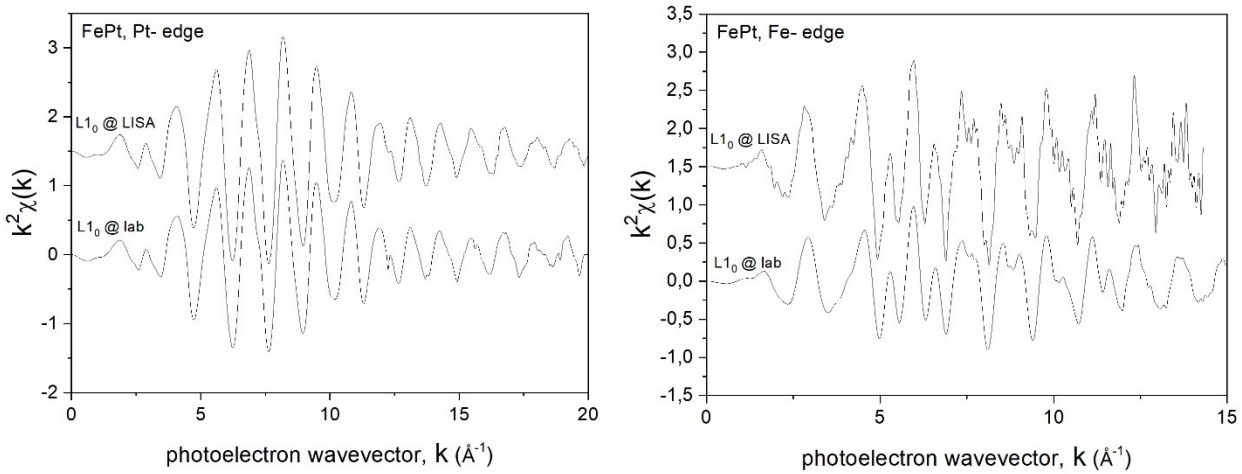
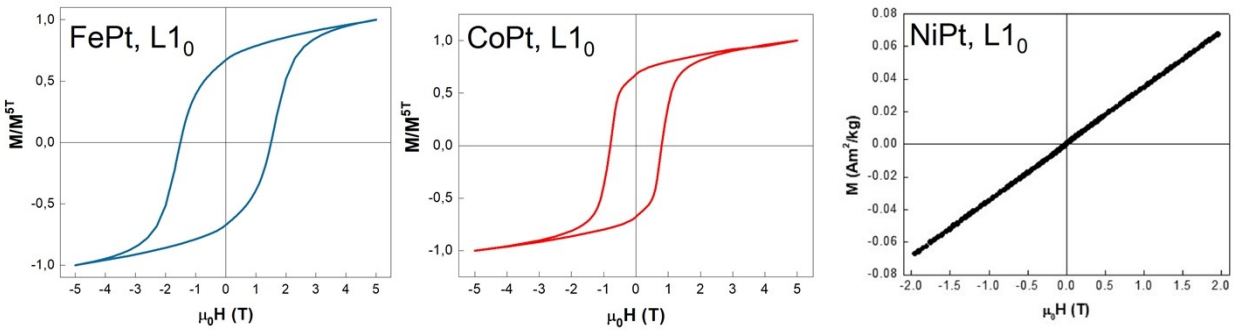


Figure S3: Characteristic room temperature hysteresis loop of the $L1_0$ phases obtained in the best PPR experimental conditions for each compound. $L1_0$ FePt and CoPt show the typical hysteresis loop of hard ferromagnetic materials[2], while NiPt present a linear anhysteretic curve characteristic of a paramagnetic material as e expected for this alloy[3].

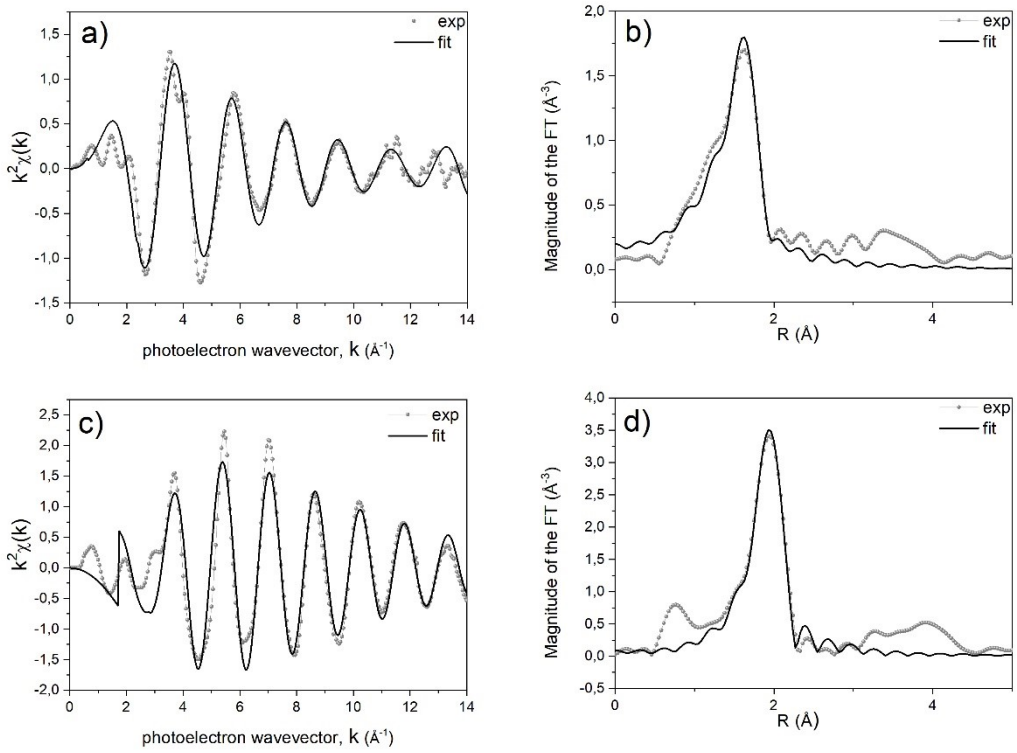


[2] *A. Cebollada, R.F.C. Farrow, M.F. Toney, Structure and magnetic properties of chemically ordered magnetic binary alloys in thin film form, in: H.S. Nalwa (Ed.), Magn. Nanostructures, American Scientific Publishers, 2002, p. 93.*

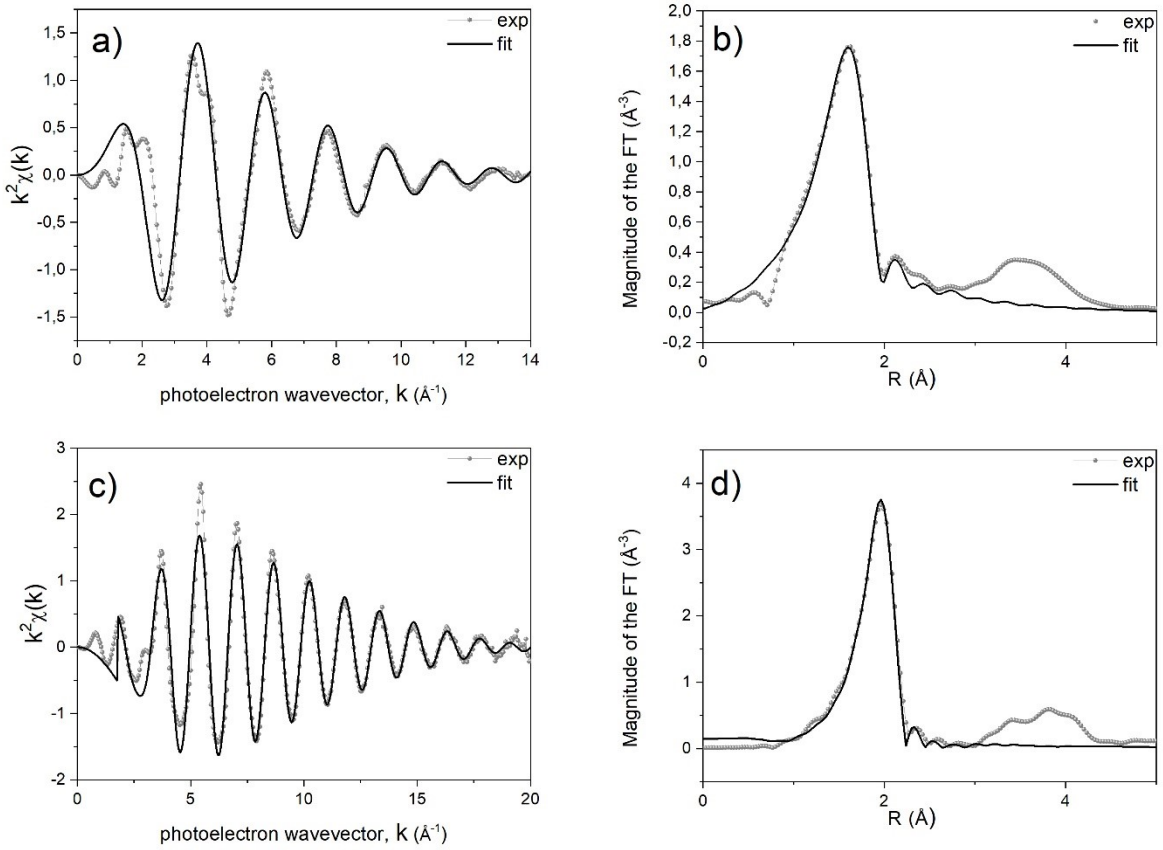
[3] *U. Kumar, P.K. Mukhopadhyay, B. Sanyal, O. Eriksson, P. Nordblad, D. Paudyal K. Tarafder, A. Mookerjee, experimental and theoretical study of annealed Ni-Pt alloys, Phys. Rev. B 74 (2006), 064401, https://doi.org/10.1103/ PhysRevB.74.064401; U. Kumar, K.G. Padmalekha, P.K. Mukhopadhyay, D. Paudyalc, A. Mookerjee, Magnetic transition in NiPt alloy systems: experiment and theory, J. Magn. Magn Mater. 292 (2005) 234e240, https://doi.org/10.1016/ j.jmmm.2004.10.116.*

Figure S4. Experimental and fitted EXAFS signal (a, c) and corresponding Fourier Transform, FT (b, d) at the Fe-K edge (a, b) and Pt-L_{III} edge (c, d) of the initial precursors.

$Fe(H_2O)_6PtCl_6$



$Co(H_2O)_6PtCl_6$



$Ni(H_2O)_6PtCl_6$

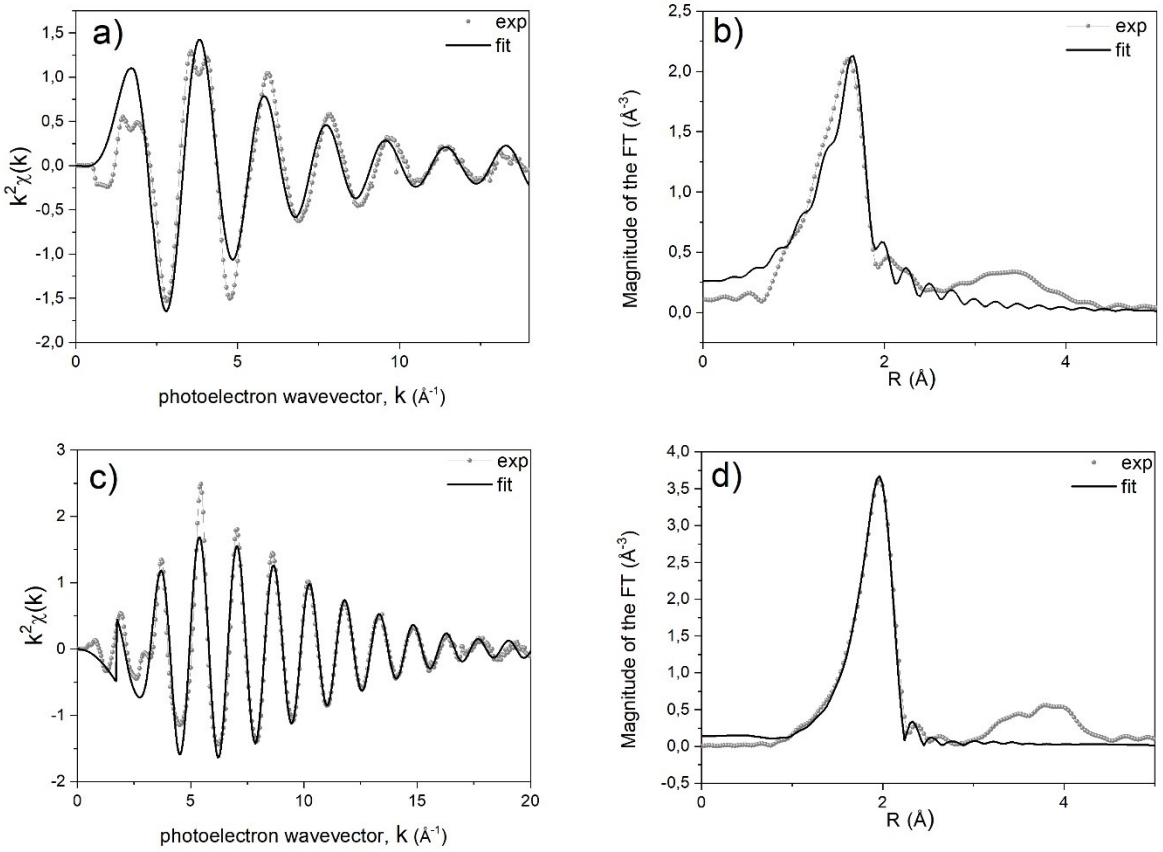


Figure S5. Experimental and fitted EXAFS signal (a, c) and corresponding Fourier Transform, FT (b, d) at the Pt-L_{III} edge of the CoPt and NiPt alloys synthesized by the PPR approach.

CoPt, NiPt $L1_0$ alloys

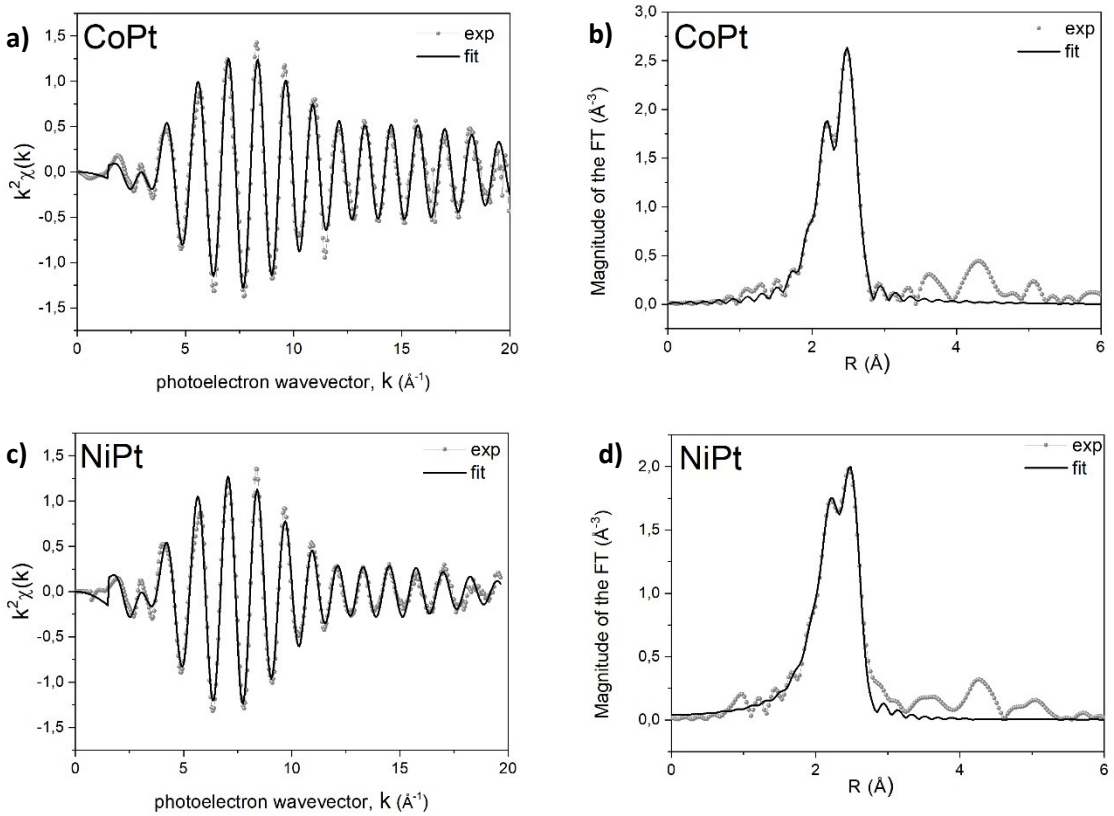


Figure S6. Contribution of the Fe-Pt and Fe-O scattering paths on the *in-situ* EXAFS oscillation (Fe-K edge) acquired at 300°C during the PPR process.

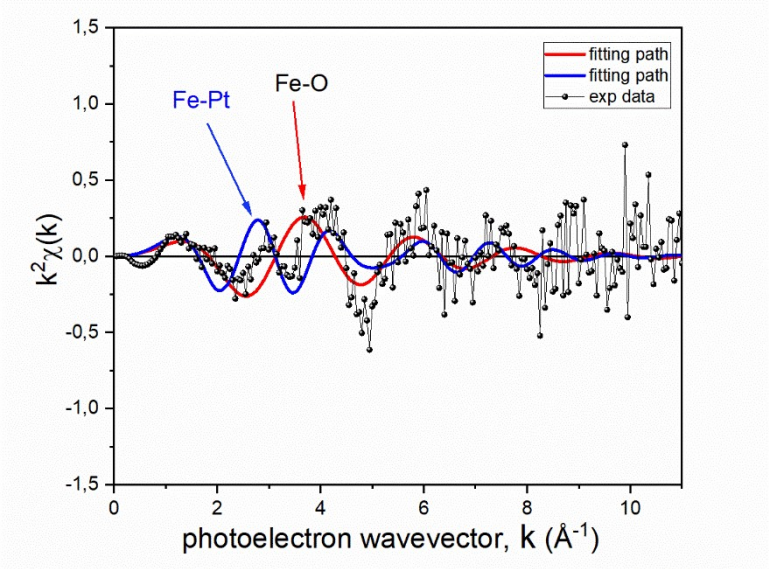


Figure S7. In-situ experimental and fitted EXAFS signal at the Pt-L_{III} edge of during the PPR treatment on the Fe-based system.

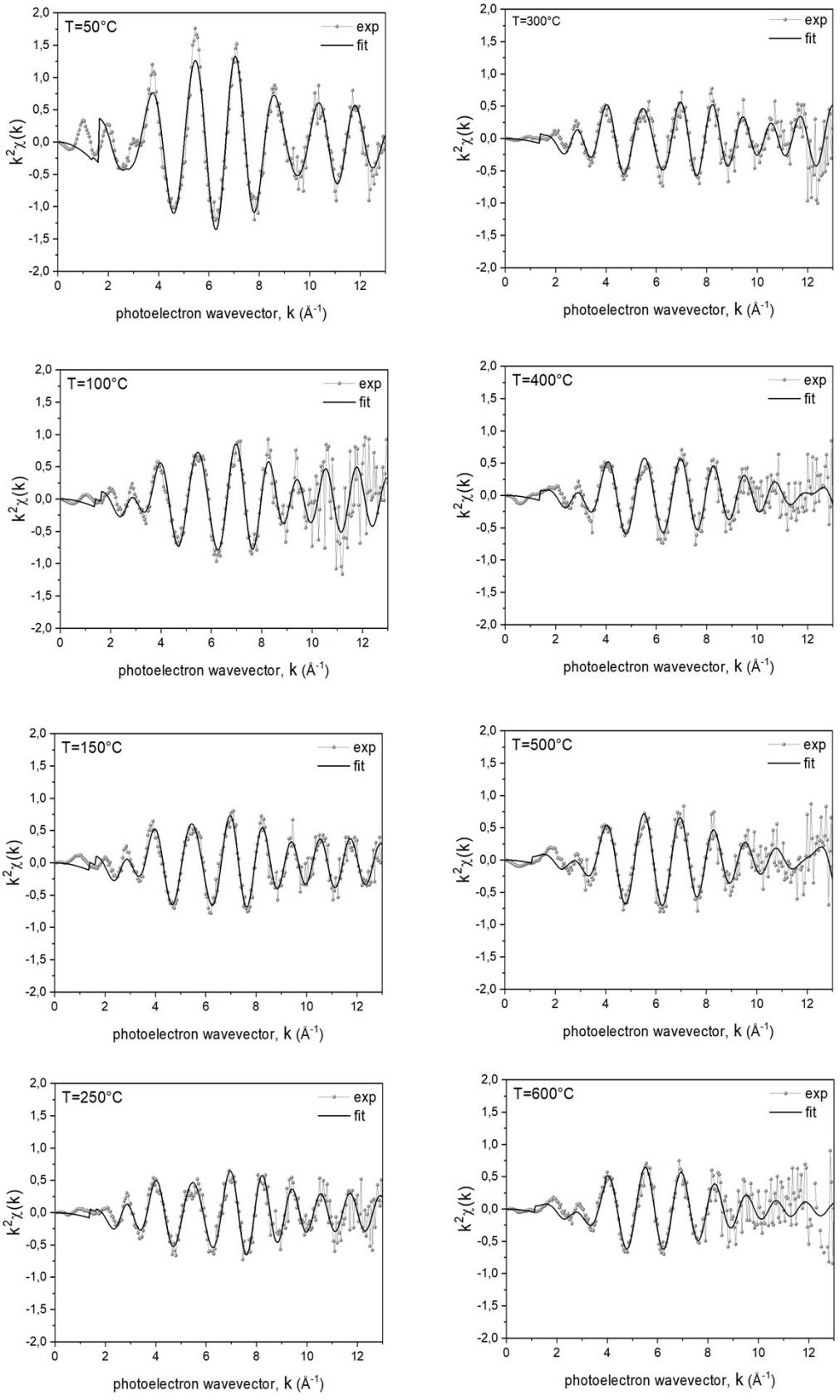


Figure S8. in-situ experimental and fitted EXAFS signal at the Fe-K edge during the treatment of the Fe-based system. Up to 150°C, the fitting model is based on 6 Fe-O scattering paths with the r_{Fe-O} distance that slightly changes with temperature (distorted octahedral) (I model). In the intermediate range of temperatures, up to 350°C, the fitting model is based on a combination of Fe-O and Fe-Pt scattering paths with no evidence of Fe-Fe distances (II model). Above 400°C the III model is based on pure FePt alloy with Fe-Fe and Fe-Pt scattering paths, consistently with a $L1_0$ phase.

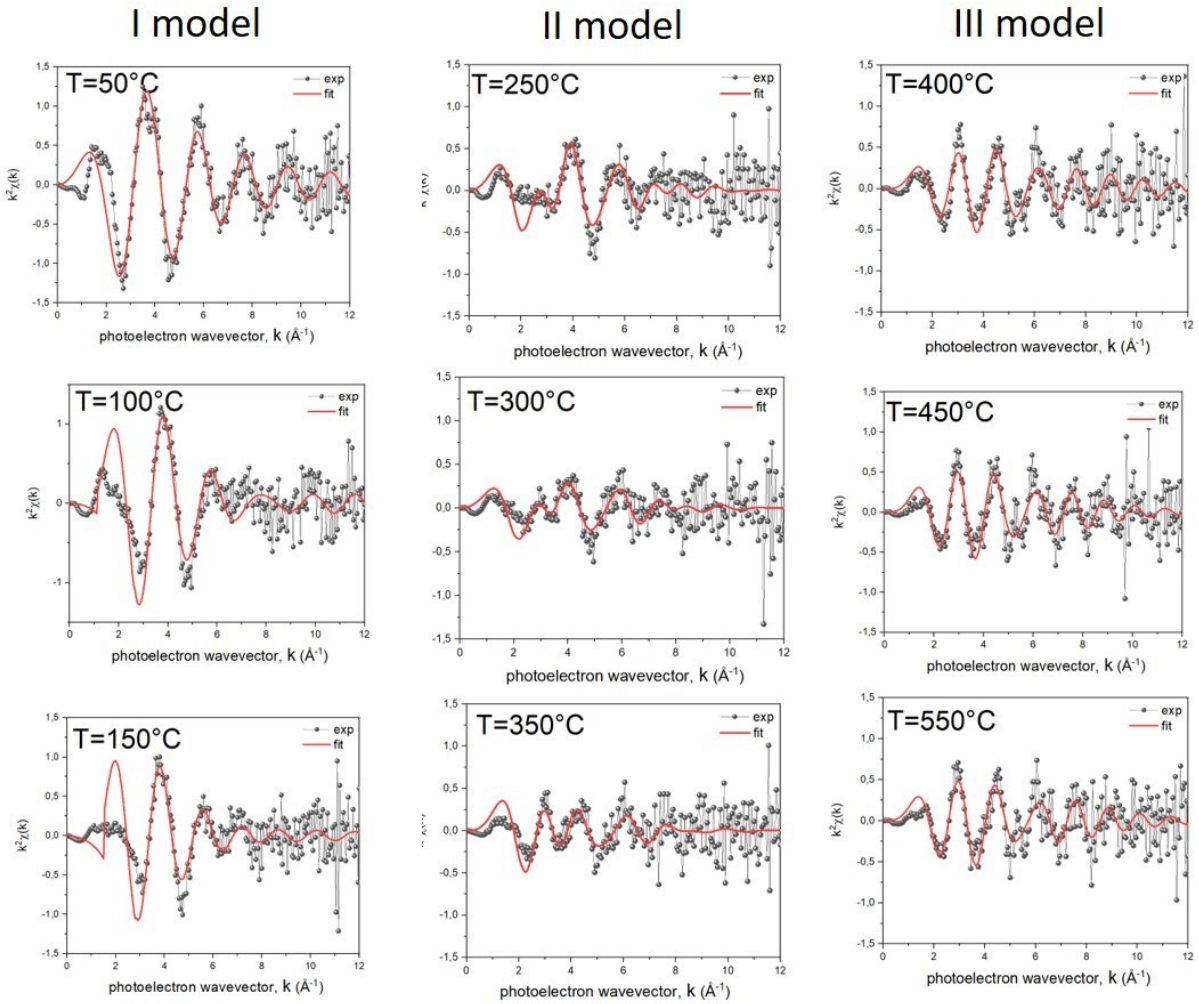


Figure S9. Comparison of the EXAFS signals of the three compounds, collected at the intermediate temperature of 300°C.