Effect of magnesium addition and high energy ball milling processing on the degradation behavior of iron in modified Hanks´solution for bioabsorbable implant applications

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High energy ball milling was carried out in a PM-4 Retsch planetary mill at 200 rpm for 2, 8 and 16 h. The ball (stainless steel, 20 mm diameter) to powder ratio was 7:1, which gives a proportion of 13 balls each 60 g powder. Four batches of Fe-Mg powder were ball milled (BM) in order to obtain four sets of Fe base alloys with 1, 3, 5 and 7 wt.% of Mg respectively (equivalently: 3, 7, 11 and 15 at. %). In order to minimize oxidation during the milling process the powders were introduced in stainless steel mill jars and sealed inside a glove box filled with argon. In addition to the four Fe-Mg powders, a fifth set of pure Fe was also ball milled following the same procedure. Table S1 shows the interplanar distances corresponding to the [110] planes of Fe obtained from X-ray diffraction of the samples, performed with a Co X-ray tube. Table S2 shows the weight percent of Mg in each alloy and for each milling time as resulted from Rietveld analysis.

From these tables, it is deduced that the alloy that combines de largest interplanar distance (indicative of solid solution of Mg in the Fe lattice) with the lowest amount of Mg phase is the one with 5 wt% of Mg milled for 16 hours.

Table S1. Interplanar distance, d (nm), of Fe-xMg powders (x=1, 3, 5, 7 wt%) milled for 2, 8 and 16 hours, corresponding to the [110] planes of Fe, and variation, Δd, with respect to the as-received Fe powder (d_{Fe}= 0.28659 Å).

Milled powder	d (2 h)	Δd (2h)	d (8h)	Δd (8h)	d (16h)	Δd (16h)
Fe	0.28665	6	0.28665	6	0.28669	10
Fe1Mg	0.28654	-5	0.28658	-1	0.28665	6
Fe3Mg	0.28659	0	0.28657	-2	0.28668	9
Fe5Mg	0.28653	-6	0.28662	3	**0.28694**	**35**
Fe7Mg	0.28664	5	0.28659	0	0.28666	7

Table S2. Weight percent of Mg phase in each alloy for each milling time.

	Milling time		
Milled powder	2 h	8 h	16 h
Fe1Mg	-	-	-
Fe3Mg	0.4	0.2	-
Fe5Mg	2.8	1.8	-
Fe7Mg	6.3	2.5	1.6