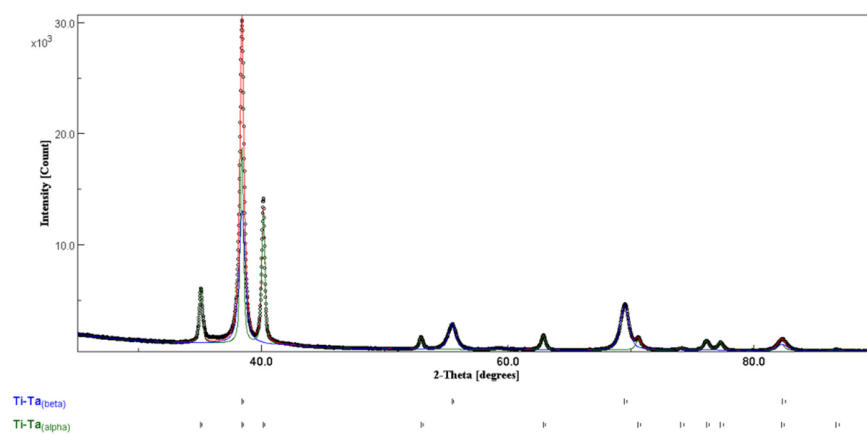
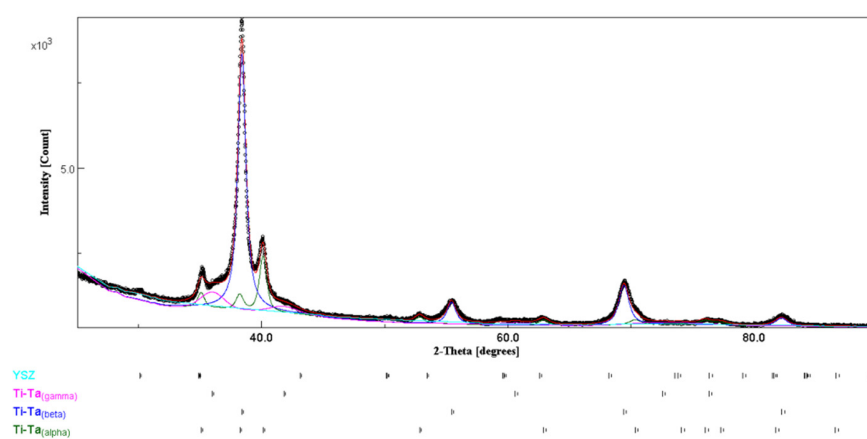


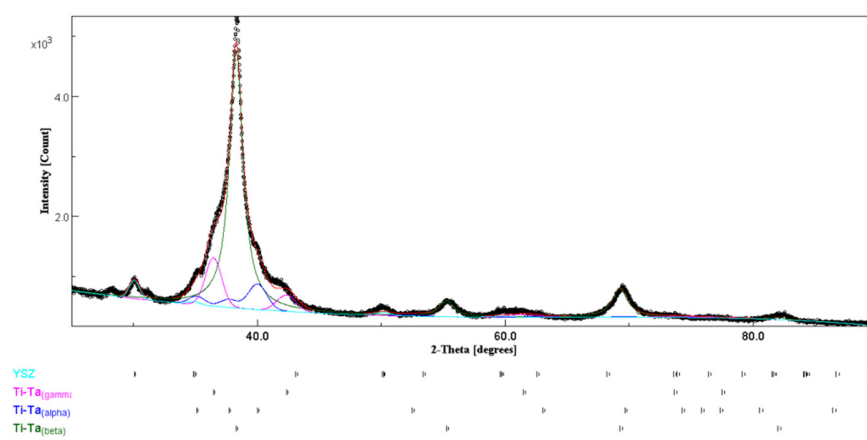
Supplementary Materials



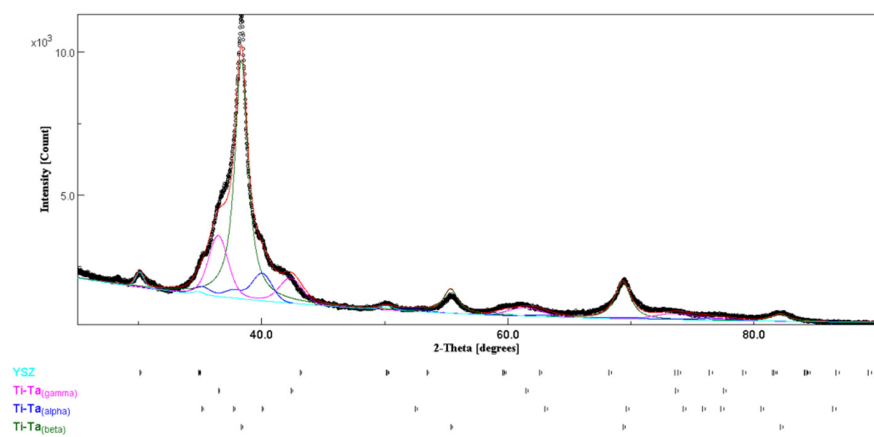
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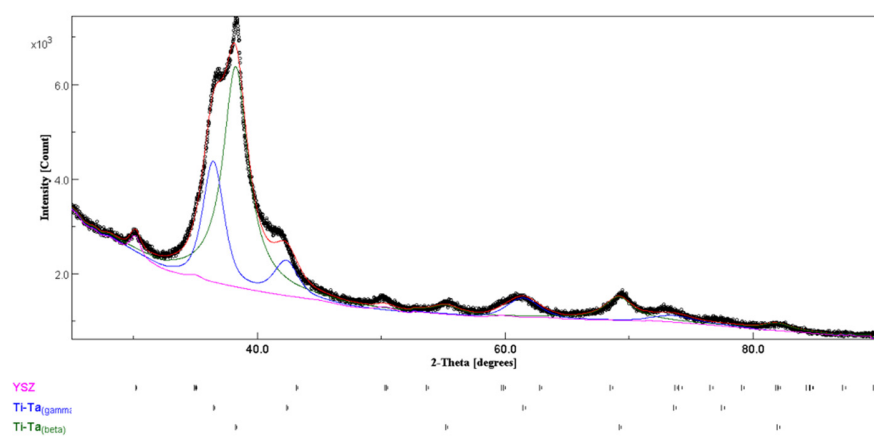
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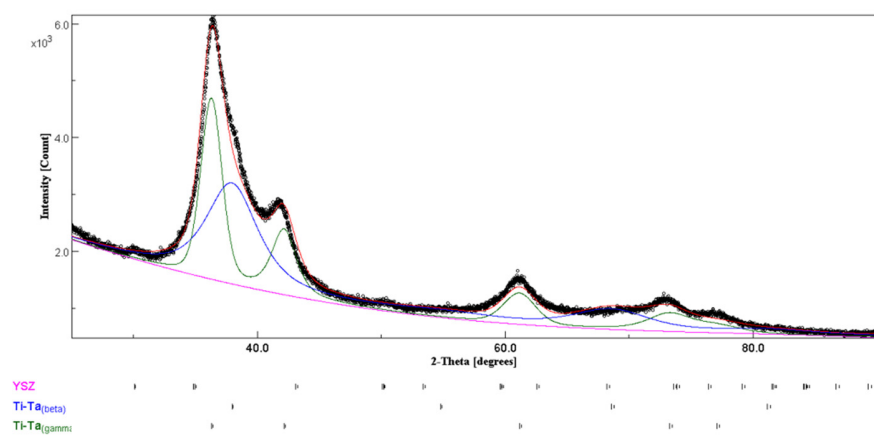
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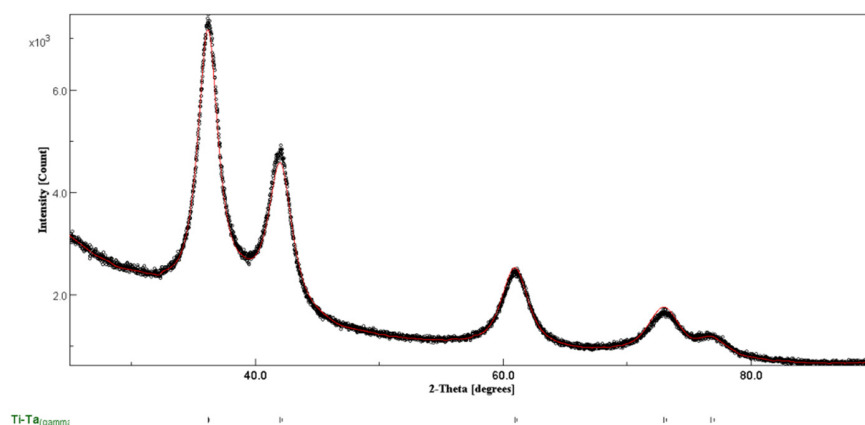
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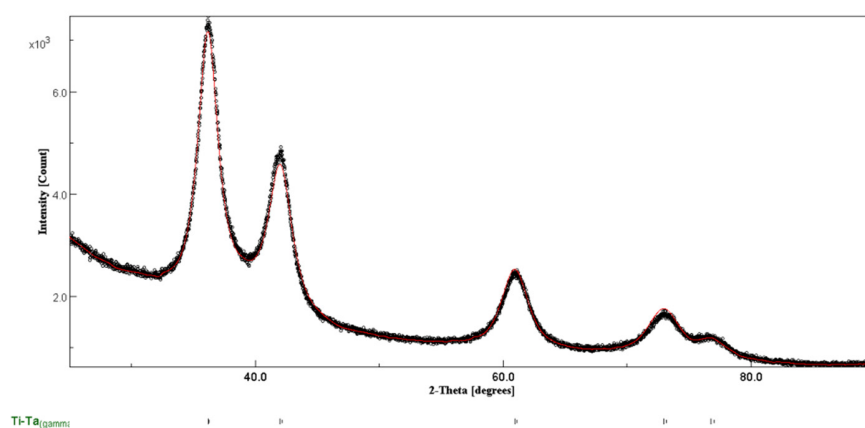
(e)



(f)

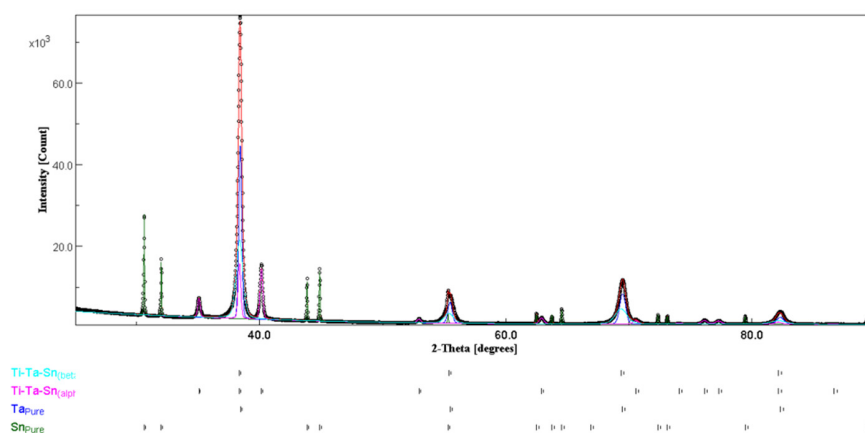


(g)

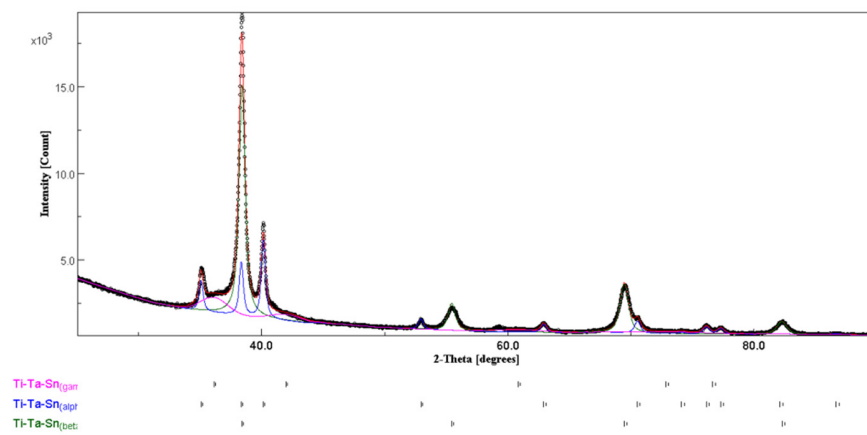


(h)

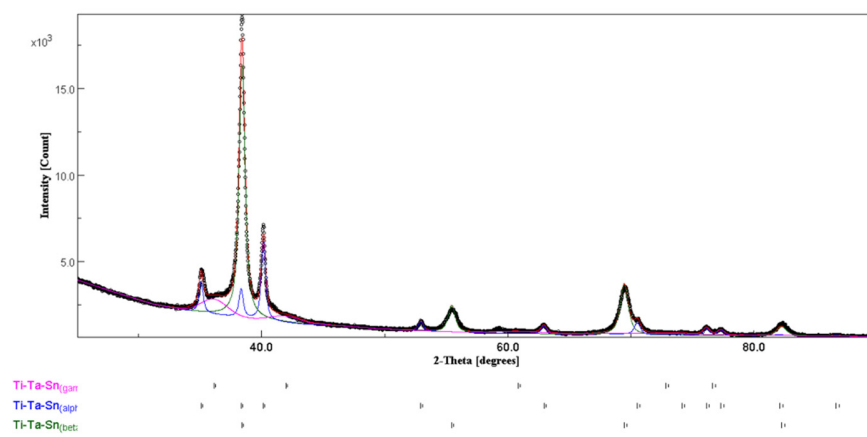
Figure S1. Rietveld refinement of the XRD patterns for the Ti-13Ta at: (a)2, (b)5, (c)10, (d)15, (e)20, (f)30, (g)50 and (h) 100 h of MA, experimental data (point) and modelling result (line).



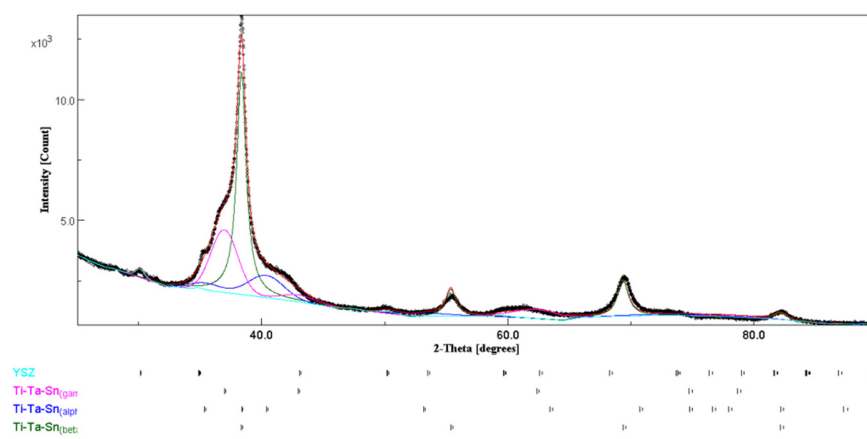
(a)



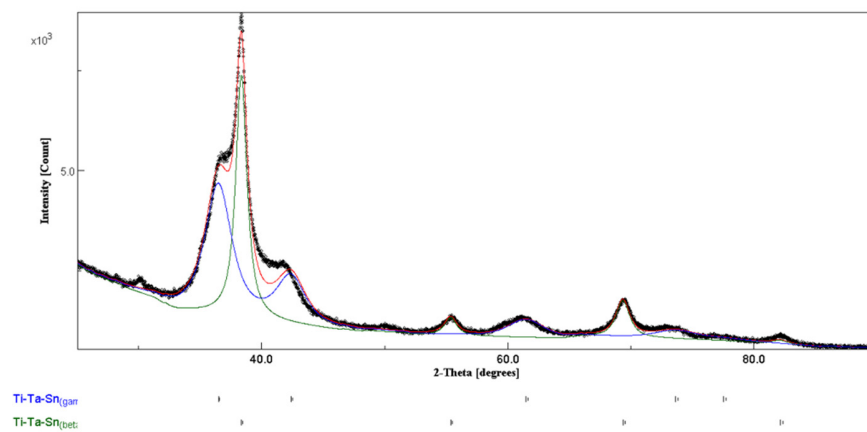
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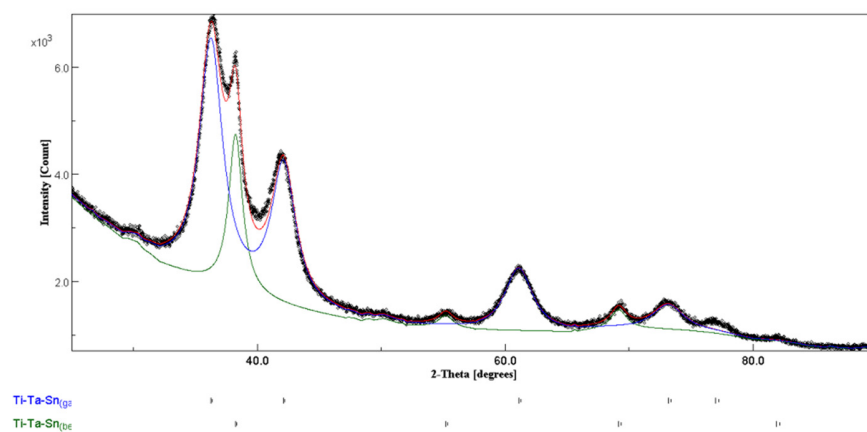
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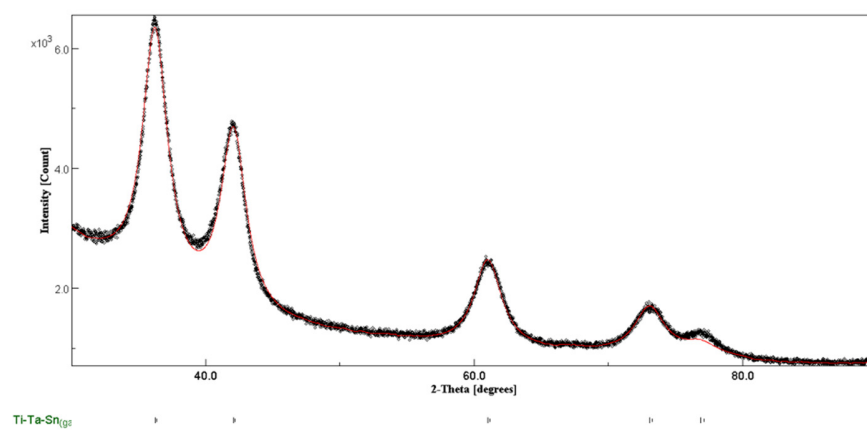
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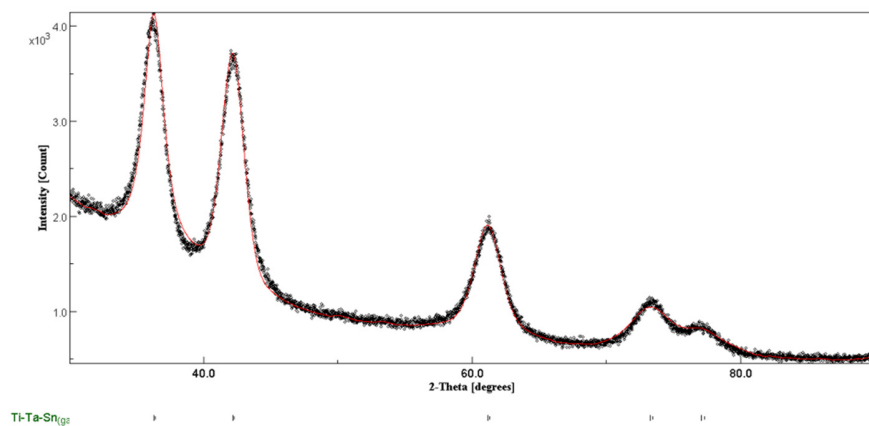
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(f)

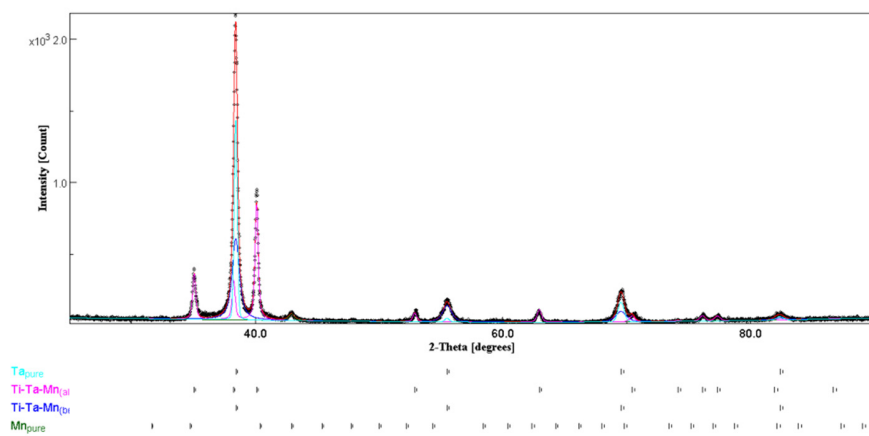


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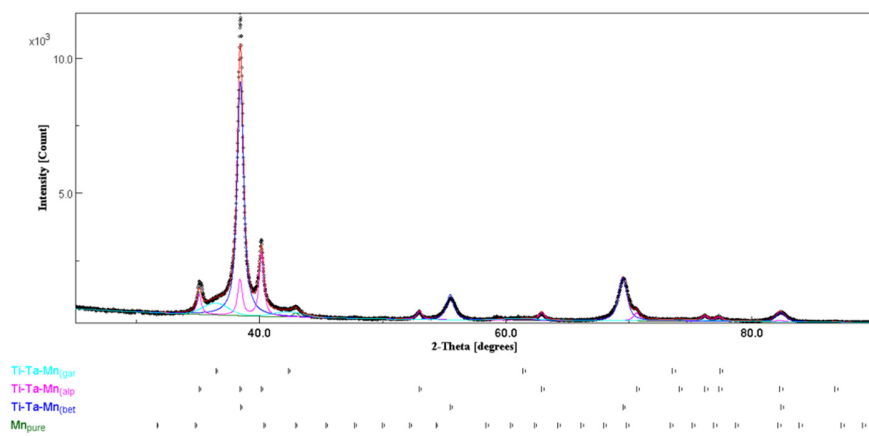


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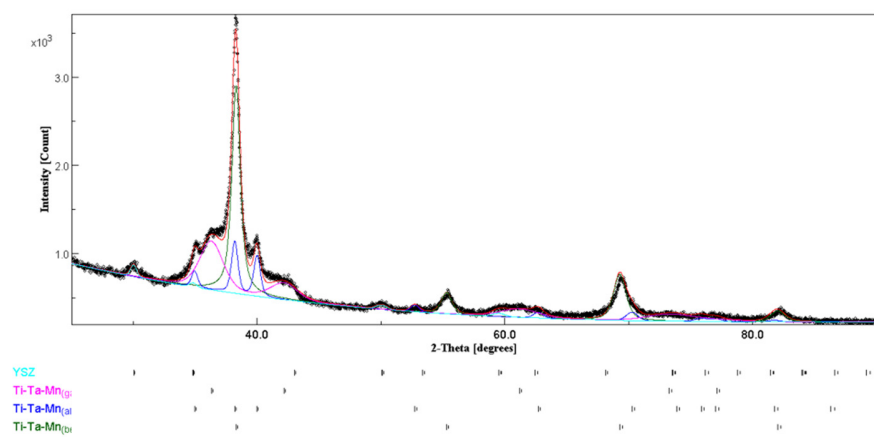
Figure S2. Rietveld refinement of the XRD patterns for the Ti-13Ta-6Sn at: (a)2, (b)5, (c)10, (d)15, (e)20, (f)30, (g)50 and (h) 100 h of MA, experimental data (point) and modelling result (line).



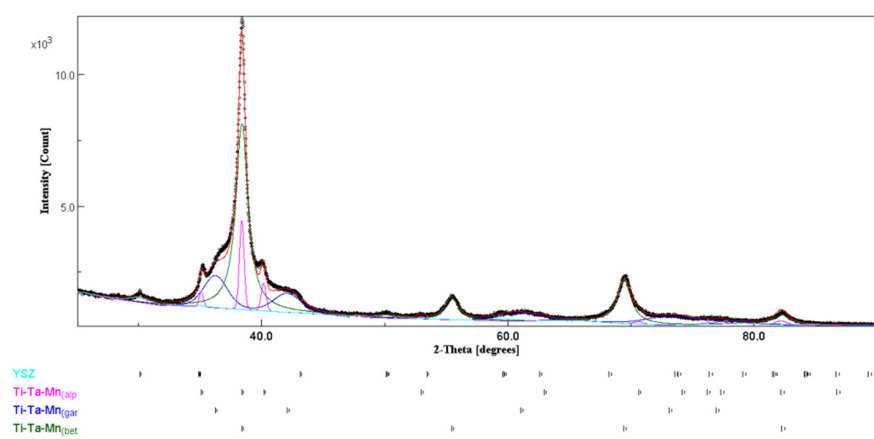
(a)



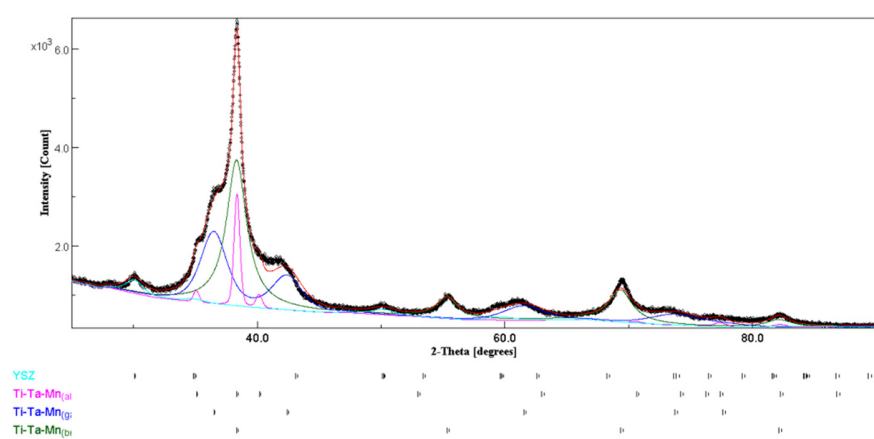
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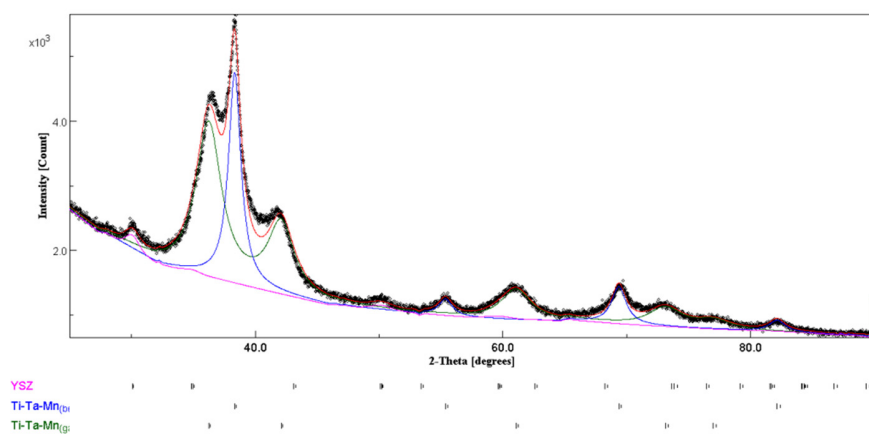
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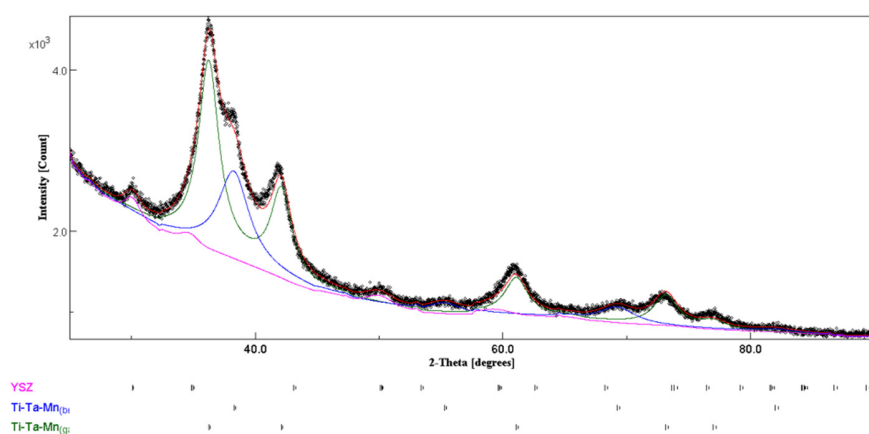
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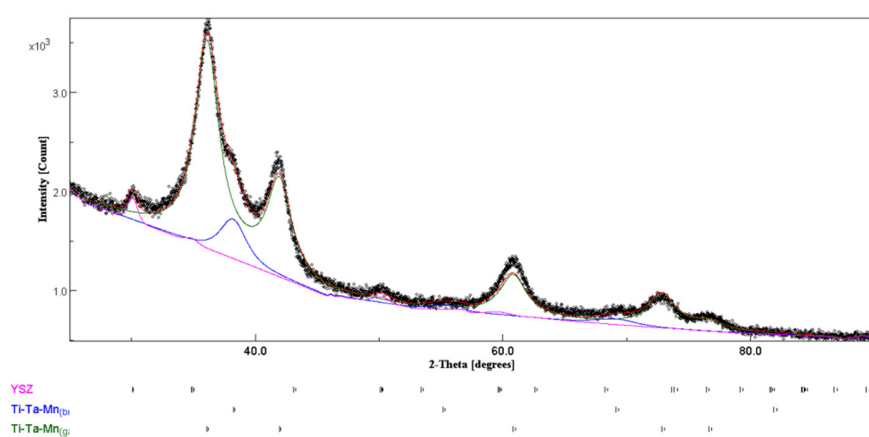
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(f)

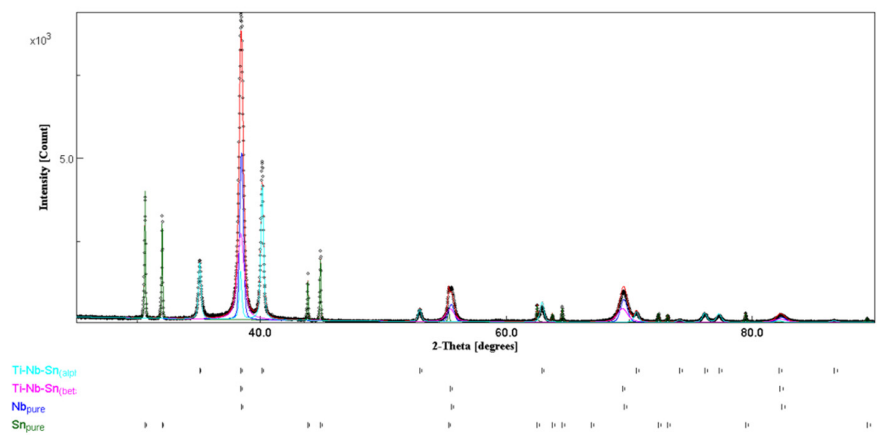


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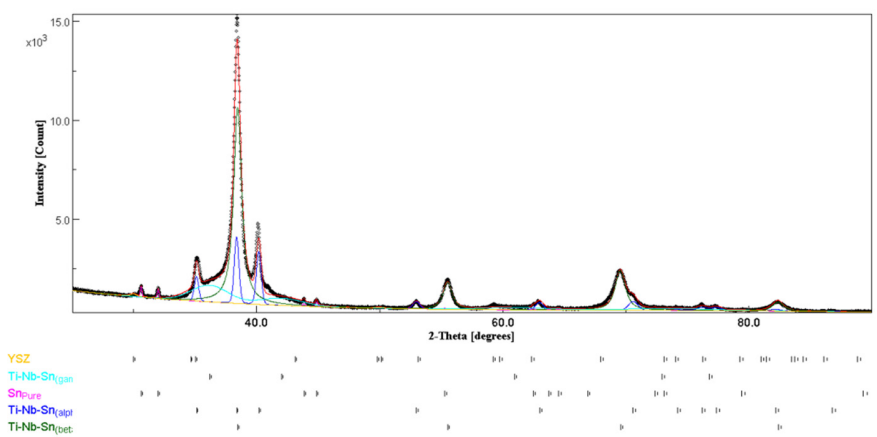


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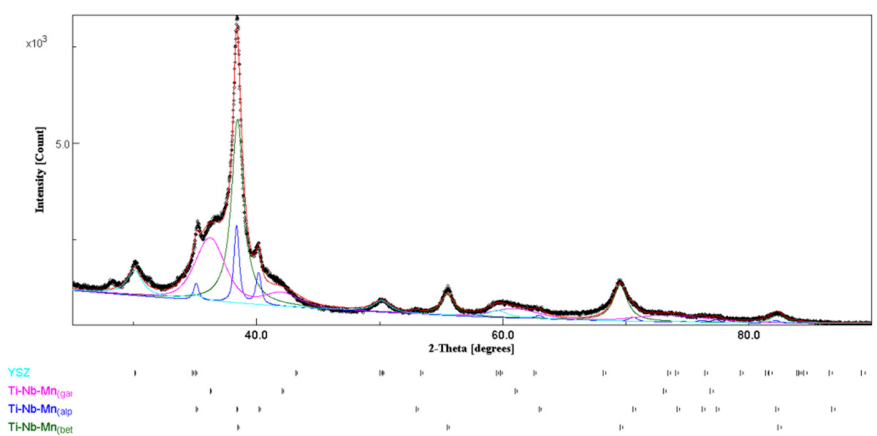
Figure S3. Rietveld refinement of the XRD patterns for the Ti-13Ta-6Mn at: (a)2, (b)5, (c)10, (d)15, (e)20, (f)30, (g)50 and (h) 100 h of MA, experimental data (point) and modelling result (line).



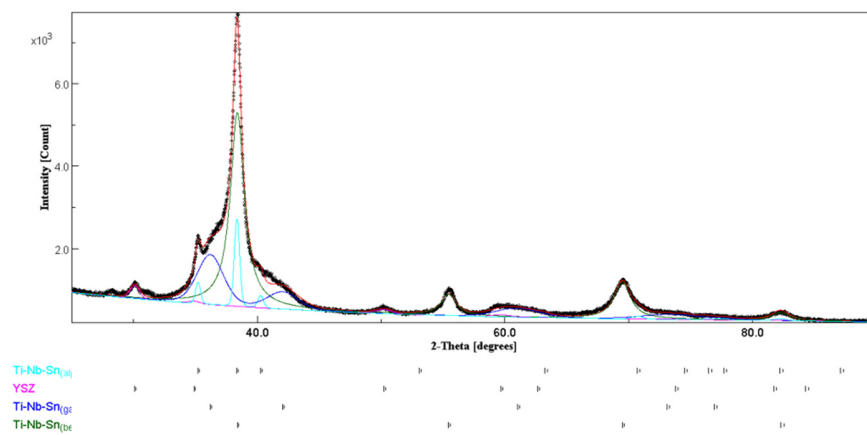
(a)



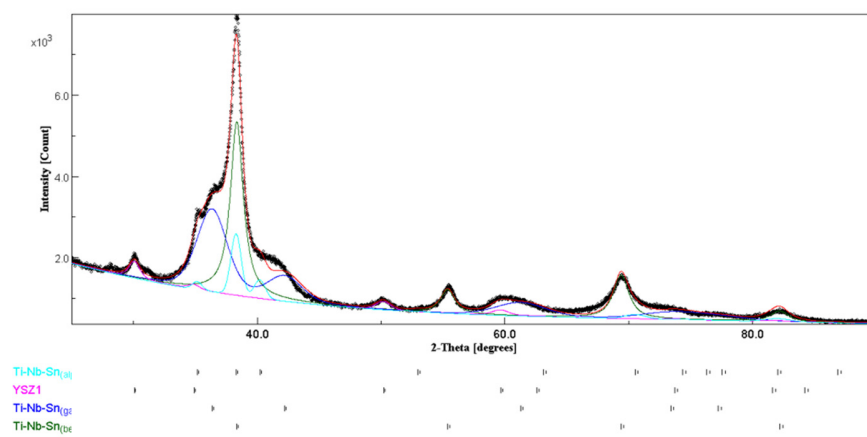
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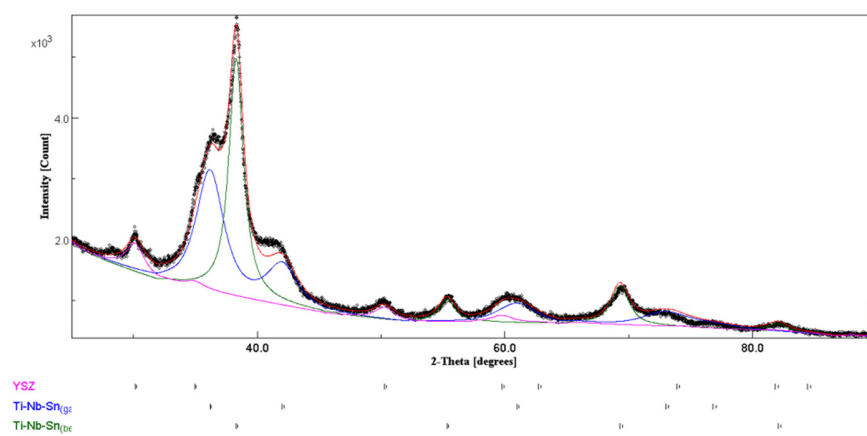
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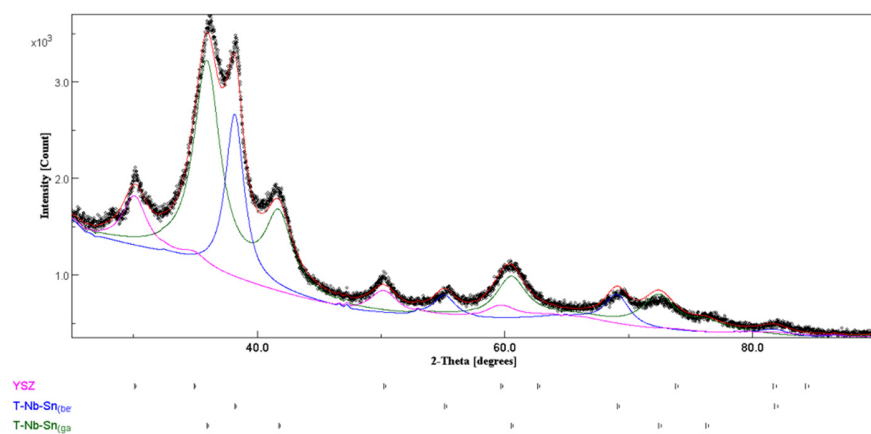
(d)



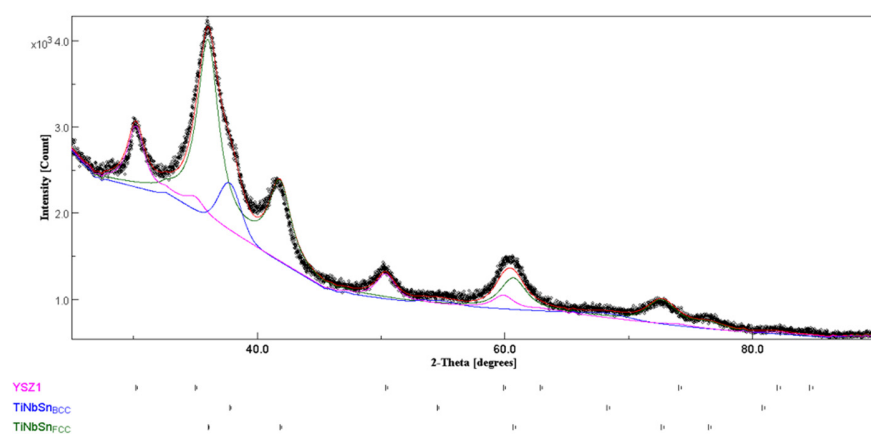
(e)



(f)



(g)



(h)

Figure S4. Rietveld refinement of the XRD patterns for the Ti-30Nb-6Sn at: (a)2, (b)5, (c)10, (d)15, (e)20, (f)30, (g)50 and (h) 100 h of MA, experimental data (point) and modelling result (line), the difference between experimental and calculated patterns is given below.

Table S1. Results of Rietveld analysis for the Ti-13Ta alloy.

Milling Time (h)	Phases	a ₀ (nm)	c ₀ (nm)	wt (%)	<D> (nm)	<ε ² > ^{1/2}	Gof	Rwp (%)
2	α-Ti-Ta	0.2955	0.4688	61.9224	58.3398	0.0019	2.6382	8.0087
	β-Ti-Ta	0.3311		38.0776	33.5950	0.0031		
5	α-Ti-Ta	0.2951	0.4705	33.6852	22.3771	0.0040	1.7428	6.1408
	β-Ti-Ta	0.3312		53.2538	14.8284	0.0025		
	γ-Ti-Ta	0.4306		5.0618	119.9700	0.0250		
	YSZ	0.3637	0.5130	7.9991	2.7834	0.0006		
10	α-Ti-Ta	0.2947	0.4766	11.6626	118.6525	0.0174	1.8320	6.7723
	β-Ti-Ta	0.3320		67.4858	11.0686	0.0057		
	γ-Ti-Ta	0.4262		13.8364	258.4350	0.0172		
	YSZ	0.3637	0.5130	7.0153	201.2066	0.0130		
15	α-Ti-Ta	0.2947	0.4765	23.1589	100.2191	0.0185	2.4664	6.9110
	β-Ti-Ta	0.3316		46.6656	8.8129	0.0029		
	γ-Ti-Ta	0.4262		22.1070	16.1270	0.0170		
	YSZ	0.3637	0.5130	8.0685	141.7744	0.0105		
20	β-Ti-Ta	0.3313		68.2580	10.4063	0.0148	2.1909	5.6445
	γ-Ti-Ta	0.4274		28.7287	8.6912	0.0174		
	YSZ	0.3618	0.5137	3.0134	80.6215	0.0118		
30	β-Ti-Ta	0.3357		61.0262	156.5503	0.0480	1.5667	4.4034
	γ-Ti-Ta	0.4282		38.6386	6.5156	0.0102		
	YSZ	0.3637	0.5130	0.3352	100.0000	0.0006		
50	γ-Ti-Ta	0.4295		100.0000	6.1665	0.0083	1.2744	3.3795
100	γ-Ti-Ta	0.4299		100.0000	5.6509	0.0104	2.5118	5.7463

Table S2. Results of Rietveld analysis for the Ti-13Ta-6Sn alloy

Milling Time (h)	Phases	a ₀ (nm)	c ₀ (nm)	wt (%)	<D> (nm)	<ε ² > ^{1/2}	Gof	Rwp (%)
2	Ta	0.3311		30.5000	406.4769	0.0032	1.8559	5.4935
	Sn	0.5834	0.3182	3.5386	304.2689	0.0004		
	α-Ti-Ta-Sn	0.2952		36.0041	69.5914	0.0019		
	β-Ti-Ta-Sn	0.3317		29.9559	29.3188	0.0031		
5	α-Ti-Ta-Sn	0.2952	0.4686	29.9700	34.5981	0.0040	1.8230	5.0103
	β-Ti-Ta-Sn	0.3311		61.2236	19.4780	0.0025		
	γ-Ti-Ta-Sn	0.4299		8.8064	326.5796	0.0250		
10	α-Ti-Ta-Sn	0.2951	0.4693	16.3602	146.1771	0.0174	1.8468	5.0064
	β-Ti-Ta-Sn	0.3308		72.4336	10.5221	0.0057		

	γ -Ti-Ta-Sn	0.4279		9.1494	133.7276	0.0172		
	YSZ	0.3633	0.5143	2.0568	82.0511	0.0130		
15	α -Ti-Ta-Sn	0.2918	0.4687	6.8179	83.5645	0.0185	1.8466	4.7873
	β -Ti-Ta-Sn	0.3316		57.3680	8.1467	0.0029		
	γ -Ti-Ta-Sn	0.4246		14.8322	65.9067	0.0170		
	YSZ	0.3630	0.5139	20.9819	5.3713	0.0130		
20	β -Ti-Ta-Sn	0.3322		67.2696	5.9804	0.0148	1.9528	5.3808
	γ -Ti-Ta-Sn	0.4287		32.7304	5.3070	0.0174		
30	β -Ti-Ta-Sn	0.3330		38.2654	6.0391	0.0480	1.4301	3.4815
	γ -Ti-Ta-Sn	0.4288		61.7346	5.6731	0.0102		
50	γ -Ti-Ta-Sn	0.4290		100.0000	4.6748	0.0083	1.3974	3.6185
100	γ -Ti-Ta-Sn	0.4289		100.0000	8.3460	0.0104	1.4988	4.7249

Table S3. Results of Rietveld analysis for the Ti-13Ta-6Mn alloy

Milling Time (h)	Phases	a_0 (nm)	c_0 (nm)	wt (%)	$\langle D \rangle$ (nm)	$\langle \epsilon^2 \rangle^{1/2}$	Gof	Rwp (%)
2	Ta	0.3309		12.5146	195.3992	0.0028	1.0118	9.6275
	Mn	0.6314		3.7371	19.6652	0.0007		
	α -Ti-Ta-Mn	0.2951	0.4700	52.6953	47.8495	0.0012		
	β -Ti-Ta-Mn	0.3309		31.0530	18.1999	0.0032		
5	Mn	0.6315		0.7357	199.0078	0.0052	1.7414	7.6521
	α -Ti-Ta-Mn	0.2951	0.4684	33.1752	27.3253	0.0016		
	β -Ti-Ta-Mn	0.3309		56.3619	19.4217	0.0024		
	γ -Ti-Ta-Mn	0.4267		9.7272	280.7575	0.0276		
10	α -Ti-Ta-Mn	0.2961	0.4709	27.7414	32.2734	0.0045	1.2527	5.9094
	β -Ti-Ta-Mn	0.3319		39.8829	12.1312	0.0001		
	γ -Ti-Ta-Mn	0.4282		28.4286	10.1965	0.0186		
	YSZ	0.3639	0.5151	3.9471	100.9036	0.0073		
15	α -Ti-Ta-Mn	0.2951	0.4686	12.0449	282.2148	0.0045	2.3352	7.0731
	β -Ti-Ta-Mn	0.3312		56.0312	9.1144	0.0012		
	γ -Ti-Ta-Mn	0.4289		25.5023	15.1674	0.0215		
	YSZ	0.3639	0.5130	6.4216	5.5675	0.0079		
20	α -Ti-Ta-Mn	0.2950	0.4687	8.4768	9.6828	0.0054	1.8100	6.3374
	β -Ti-Ta-Mn	0.3318		47.6704	8.3450	0.0025		
	γ -Ti-Ta-Mn	0.4281		38.1104	6.0282	0.0115		
	YSZ	0.3639	0.5130	5.7424	8.3060	0.0104		
30	β -Ti-Ta-Mn	0.3320		44.2039	5.5591	0.0016	1.5287	4.2387
	γ -Ti-Ta-Mn	0.4288		51.7137	5.2463	0.0088		
	YSZ	0.3639	0.5130	4.0824	21.4470	0.0133		
50	β -Ti-Ta-Mn	0.3322		28.2918	3.5433	0.0050	1.2844	3.5526
	γ -Ti-Ta-Mn	0.4288		68.1822	4.7886	0.0009		

	YSZ	0.3639	0.5130	3.5260	93.7982	0.0186		
	β -Ti-Ta-Mn	0.3326		13.4192	5.4027	0.0121		
100	γ -Ti-Ta-Mn	0.4304		82.8792	4.7974	0.0025	1.8171	5.6556
	YSZ	0.3639	0.5130	3.7016	100.3447	0.0122		

Table S4. Results of Rietveld analysis for the Ti-30Nb-6Sn alloy

Milling Time (h)	Phases	a ₀ (nm)	c ₀ (nm)	wt (%)	<D> (nm)	< ϵ^2 > ^{1/2}	Gof	Rwp (%)
2	Nb	0.3306		21.5655	111.1632	0.0031	1.7466	9.6688
	Sn	0.5834	0.3182	6.9359	222.7709	0.0004		
	α -Ti-Nb-Sn	0.2952	0.4687	43.5371	61.4815	0.0014		
	β -Ti-Nb-Sn	0.3313		27.9616	22.0082	0.0032		
5	Sn	0.5835	0.3184	0.9890	217.5771	0.0019	2.4367	8.6514
	α -Ti-Nb-Sn	0.2949	0.4687	21.2356	125.9885	0.0042		
	β -Ti-Nb-Sn	0.3308		59.5146	14.4054	0.0018		
	γ -Ti-Nb-Sn	0.4281		17.2425	325.5034	0.0323		
	YSZ	0.3658	0.5117	1.0184	17.3204	0.0018		
10	α -Ti-Nb-Sn	0.2950	0.4687	8.8433	17.8810	0.0006	2.2009	7.7422
	β -Ti-Nb-Sn	0.3308		43.6639	10.6576	0.0000		
	γ -Ti-Nb-Sn	0.4293		33.9771	7.4004	0.0235		
	YSZ	0.3644	0.5117	13.5158	7.0611	0.0023		
15	α -Ti-Nb-Sn	0.2939	0.4688	7.5281	149.0952	0.0048	1.5709	6.3150
	β -Ti-Nb-Sn	0.3312		59.5812	8.2175	0.0004		
	γ -Ti-Nb-Sn	0.4292		27.4034	10.9229	0.0229		
	YSZ	0.5135		3.1935	97.9051	0.0113		
20	α -Ti-Nb-Sn	0.2944	0.4696	2.3420	203.4136	0.0071	2.0664	6.5469
	β -Ti-Nb-Sn	0.3316		49.6064	8.7652	0.0023		
	γ -Ti-Nb-Sn	0.4285		40.6812	8.8012	0.0249		
	YSZ	0.3644	0.5138	7.3705	9.9253	0.0056		
30	β -Ti-Nb-Sn	0.3320		41.0940	7.0092	0.0026	1.5134	4.8373
	γ -Ti-Nb-Sn	0.4296		47.2171	4.9228	0.0124		
	YSZ	0.3644	0.5127	11.6889	5.7251	0.0028		
50	β -Ti-Nb-Sn	0.3329		24.9448	6.3600	0.0049	1.4656	4.9700
	γ -Ti-Nb-Sn	0.4324		57.4478	4.1944	0.0041		
	YSZ	0.3644	0.5135	0.1867	4.6144	0.0063		
100	β -Ti-Nb-Sn	0.3363		10.4133	67.7282	0.0217	1.4646	4.2582
	γ -Ti-Nb-Sn	0.4314		66.2735	5.5910	0.0063		
	YSZ	0.3644	0.5119	23.3132	6.6042	0.0044		