

Influence of Cr Substitution and Temperature on Hierarchical Phase Decomposition in the AlCoFeNi High Entropy Alloy

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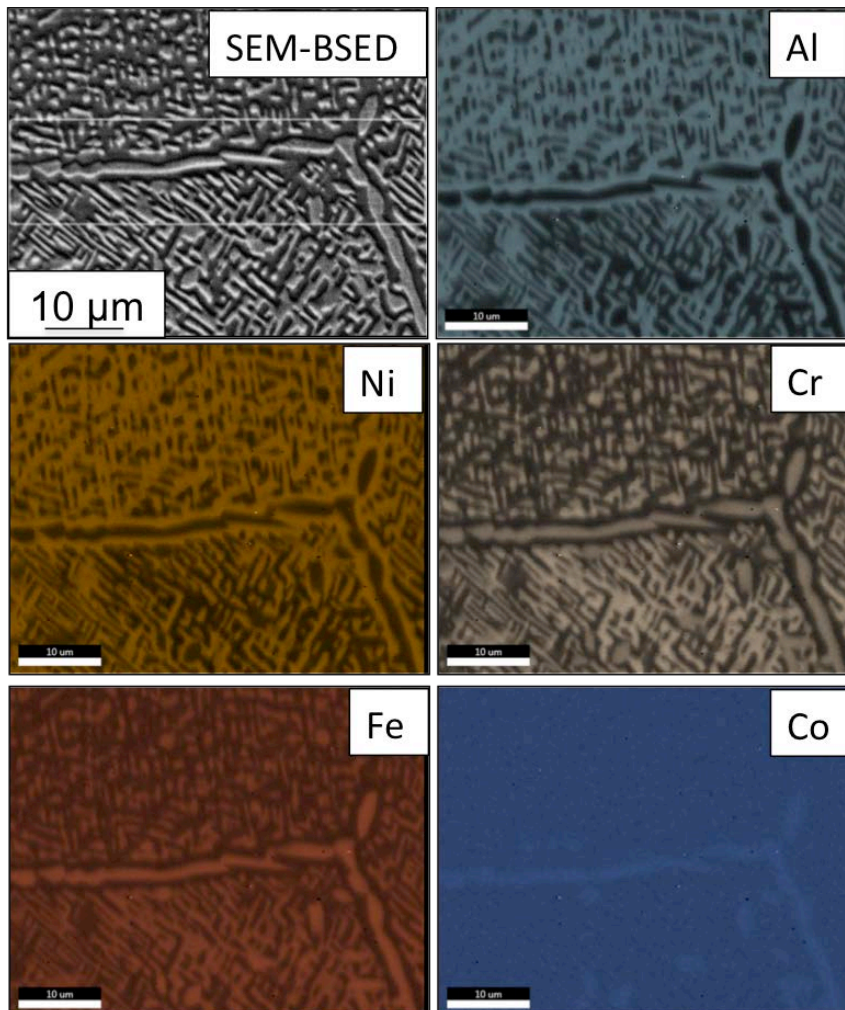
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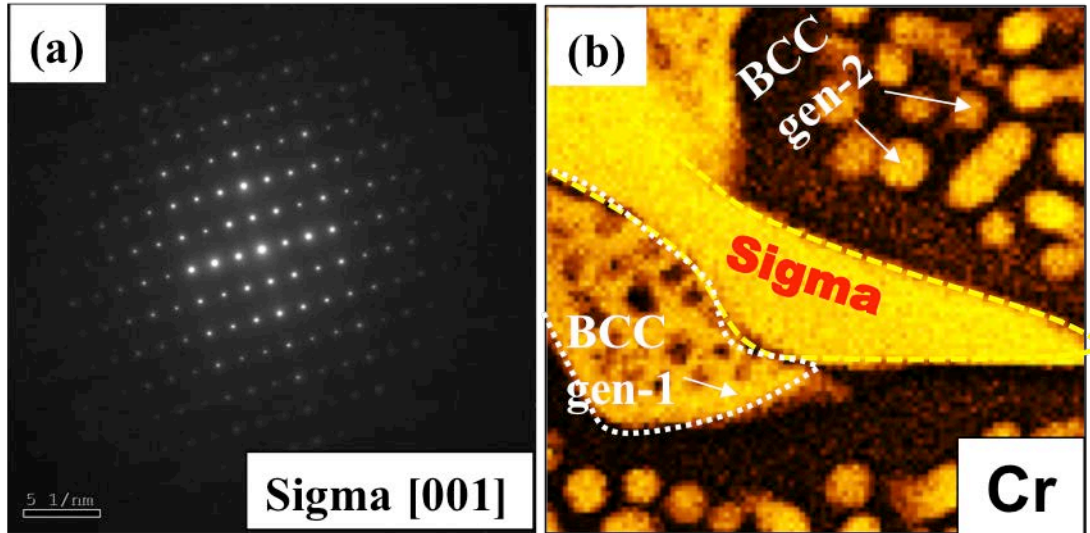
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Supplementary Figures:

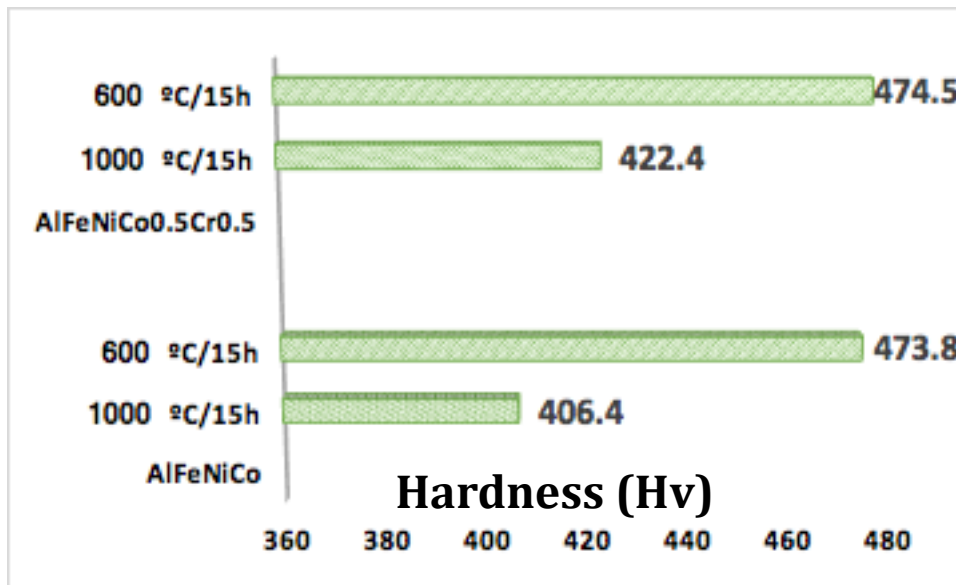
Supplementary Figure 1: SEM-EDS maps from AlCo_{0.5}Cr_{0.5}FeNi alloy annealed for 15 h at 1000 °C.



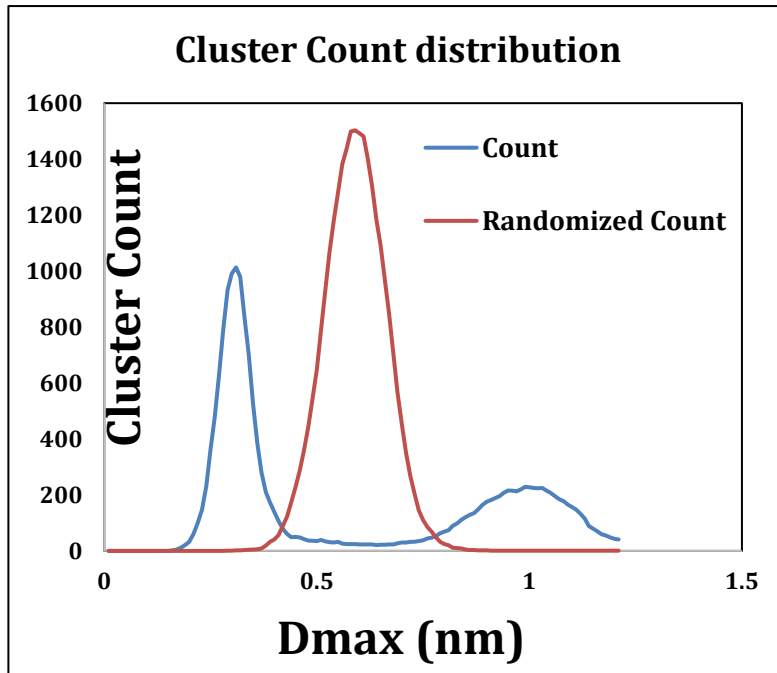
Supplementary Figure 2: TEM results from the grain boundary region in AlCo0.5Cr0.5FeNi alloy annealed for 15 h at 600 °C, (a) SADP from sigma phase (b) STEM-EDS map showing the partitioning of Cr.



Supplementary Figure 3: Microhardness of the AlCoFeNi and AlCo0.5Cr0.5FeNi alloys after annealing treatments at 600°C and 1000°C.



Supplementary Figure 4: Cluster count distribution analysis on the APT data from the AlCo_{0.5}Cr_{0.5}FeNi alloy after annealing treatments at 600°C.



Supplementary Tables:

Supplementary Table 1: STEM-EDS composition (at%) of the phases present in AlCo_{0.5}Cr_{0.5}FeNi alloy after 600 °C/15 h annealing.

Phases→	Sigma		B2		Gen-1 BCC		Gen-2 BCC	
Elements	At%	Uncert.%	At%	Uncert.%	At%	Uncert.%	At%	Uncert.%
Al(k)	1.05	0.01	28.23	0.2	10.51	0.11	11.12	0.14
Cr(k)	43.67	0.14	5.52	0.13	27.52	0.26	26.2	0.3
Fe(k)	40.3	0.16	17.77	0.26	38.4	0.34	38.81	0.41
Co(k)	12.61	0.09	14.36	0.24	12.84	0.21	11.6	0.25
Ni(k)	2.35	0.04	34.09	0.36	10.71	0.19	12.25	0.24

Supplementary Table 2: Comparison of saturation magnetization (Ms) and coercivity (Hc) of high entropy alloys.

HEAs	Phase(s)	Ms(emu/g)	Hc (Oe)	Ref
AlCoCrCuFeNi	-	16-38	15-45	²²
AlCoCrCuFeNi	-	44-48	44-264	²⁸
AlCoCrFeNi	BCC	64	51.4	²⁹
AlCoCuFeNi	BCC + FCC	84	162	³⁰
AlCoCrFeNiNb _{0.25}	BCC + Laves	25	94	²⁹

$\text{Al}_{0.25}\text{CoFeMn}_{0.25}\text{Ni}$	FCC	101	3.5	21
CoCrFeMnNi	FCC	1.39	135	31
CoFeMnNiSn	L21 + BCC	80	43	31
CoFeGaMnNi	BCC + FCC	80	11.5	31
AlCoFeMnNi	B2+BCC	148	7.9	31
$(\text{AlCu})_{0.8}\text{FeCoGa}_x\text{Ni}$ ($0 \leq x \leq 0.08$)	BCC+FCC	79-83	4.5-8.6	32
$\text{Al}_{1.25}\text{FeCoCrNi}$	BCC	43	18	33
CoCrFeNiPd_{1-2}	FCC	33-34	-	34
$\text{Al}_2\text{CoCrFeNi}$	BCC	13-18	-	34
AlCoFeNi		100-112	4-15	This work
$\text{AlCo}_{0.5}\text{Cr}_{0.5}\text{FeNi}$		42-46	39-96	This work

Supplementary Figure captions:

Supplementary Fig. 1. SEM-EDS maps from AlCo_{0.5}Cr_{0.5}FeNi alloy annealed for 15 h at 1000 °C.

Supplementary Fig. 2. TEM results from the grain boundary region in AlCo_{0.5}Cr_{0.5}FeNi alloy annealed for 15 h at 600 °C, (a) SADP from sigma phase (b) STEM-EDS map showing the partitioning of Cr.

Supplementary Fig. 3. Microhardness of the AlCoFeNi and AlCo_{0.5}Cr_{0.5}FeNi alloys after annealing treatments at 600°C and 1000°C.

Supplementary Fig. 4. Cluster count distribution analysis on the APT data from the AlCo_{0.5}Cr_{0.5}FeNi alloy after annealing treatments at 600°C.

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Supplementary Table 1: STEM-EDS composition (at %) of the phases present in AlCo_{0.5}Cr_{0.5}FeNi alloy after 600°C/15hrs annealing.

Supplementary Table 2. Comparison of saturation magnetization (M_s) and coercivity (H_c) of high entropy alloys.