Application Note EDXRF1884

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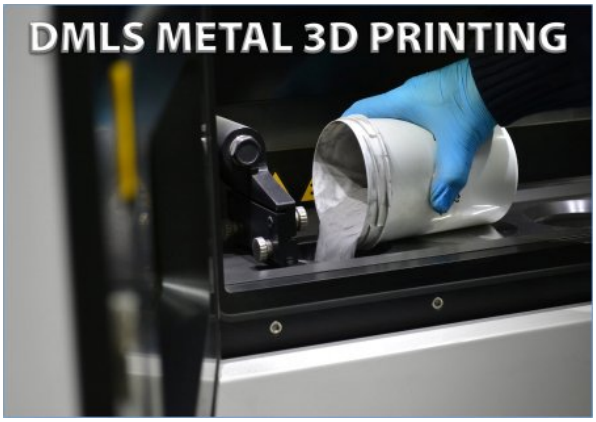
EDXRF1884 - Alloy Powders for 3D Printing

Scope

The analysis of alloy powders used for 3D printing is demonstrated.

Background



DMLS (Direct Metal Laser Sintering) is an industrial metal 3D printing method that fuses layers of fine metal powder particles, creating a metal part layer by layer. Metal 3D printing techniques are ideal for manufacturing complex metal shapes that can be expensive or impossible to produce using traditional manufacturing methods. Metal 3D printed parts are typically stronger and denser than those made by traditional casting. The DMLS process is used for prototyping metals parts and low volume manufacturing, eliminating expensive and time-consuming tooling. When mixing various metal alloy powders, it is important to monitor the elemental compositions of the raw materials and powder mixtures to ensure proper alloy balances for the parts being produced. Applied Rigaku Technologies offers the Rigaku NEX CG EDXRF spectrometer for fast and simple analysis of metal alloy powders used in metal 3D printing.

Model NEX CG

Analytical results

Sample ID: Al-Si-Mg **Units: Mass%**		
Component	**Result**	**Stat. error**
Mg	0.492	0.0138
Al	88.97	Balance
Si	10.25	0.0146
P	ND*	0.0003
S	0.0029	0.0001
Cl	0.0008	0.0001
Ti	0.0071	0.0004
V	0.0107	0.0004
Cr	0.0015	0.0002
Mn	0.0029	0.0001
Fe	0.236	0.0009
Co	ND*	0.0001
Ni	0.0051	0.0002
Cu	0.0069	0.0002
Zn	0.0062	0.0001
Ga	0.0096	0.0002

Y	ND*	<0.0001
Nb	ND*	0.0002
Mo	ND*	0.0008
Sn	0.0014	0.0004
Pb	0.0013	0.0001

Sample ID: Ti-Al-V
Units: Mass%

Component	Result	Stat. error
Mg	ND*	0.0048
Al	4.32	0.0090
Si	0.0498	0.0007
P	0.0146	0.0002
S	0.0067	0.0001
Cl	0.0027	0.0001
Ti	91.22	0.1022
V	4.18	0.0197
Cr	ND*	0.0046
Mn	ND*	0.0005
Fe	0.200	0.0025
Co	ND*	0.0005
Ni	0.0073	0.0005
Cu	0.0029	0.0003
Zn	ND*	0.0002
Ga	ND*	0.0004
Y	ND*	0.0001
Nb	ND*	0.0011
Mo	ND*	0.0033

Sample ID: PHSS
Units: Mass%

Component	Result	Stat. error
Mg	ND*	0.0053

Al	0.0698	0.0014
Si	0.578	0.0025
P	0.0161	0.0003
S	0.0181	0.0003
Cl	0.0144	0.0001
Ti	ND*	0.0029
V	ND*	0.0017
Cr	16.36	0.0287
Mn	0.131	0.0103
Fe	74.42	0.0539
Co	0.237	0.0097
Ni	4.20	0.0172
Cu	3.57	0.0140
Zn	ND*	0.0010
Ga	ND*	0.0005
Y	ND*	0.0002
Nb	0.382	0.0109
Mo	ND*	0.0079

Sample ID: 316LSS **Units: Mass%**		
Component	**Result**	**Stat. error**
Mg	ND*	0.0050
Al	0.0617	0.0015
Si	0.582	0.0026
P	0.0042	0.0005
S	ND*	0.0013
Cl	ND*	0.0001
Ti	ND*	0.0028
V	ND*	0.0020
Cr	18.14	0.0293
Mn	1.17	0.0119
Fe	63.59	0.0489

Co	0.254	0.0088
Ni	13.38	0.0270
Cu	ND*	0.0029
Zn	ND*	0.0006
Ga	ND*	0.0004
Y	ND*	0.0002
Nb	ND*	0.0098
Mo	2.81	0.0653

Sample ID: INC625 **Units: Mass%**		
Component	**Result**	**Stat. error**
Mg	ND*	0.0057
Al	0.134	0.0025
Si	0.0533	0.0011
P	ND*	0.0010
S	ND*	0.0027
Cl	ND*	0.0003
Ti	0.125	0.0022
V	ND*	0.0010
Cr	19.19	0.0181
Mn	0.0923	0.0048
Fe	0.0511	0.0008
Co	0.0326	0.0006
Ni	65.89	0.0351
Cu	0.184	0.0044
Zn	ND*	0.0008
Ga	ND*	0.0006
Y	0.0078	0.0011
Nb	4.32	0.0371
Mo	9.92	0.1277

Sample ID: INC718 Units: Mass%		
Component	**Result**	**Stat.error**
Mg	ND*	0.0057
Al	0.256	0.0030
Si	0.0798	0.0012
P	ND*	0.0009
S	ND*	0.0018
Cl	ND*	0.0002
Ti	0.901	0.0065
V	0.0158	0.0023
Cr	17.61	0.0212
Mn	0.177	0.0062
Fe	16.88	0.0181
Co	0.242	0.0034
Ni	53.07	0.0347
Cu	0.365	0.0043
Zn	ND*	0.0008
Ga	ND*	0.0006
Y	ND*	0.0007
Nb	6.68	0.0465
Mo	3.71	0.0825

** ND means the component was not detected*

Discussion

Standardless semi-quant Fundamental Parameters (FP) is used for the analysis using the NEX CG Pellet template. For metal alloy powders, no balance component is required since metals contain only trace or no organic elements, and do not affect the measurement of the measureable elements Na-U. Rigaku RPF-SQX FP uses advanced theory to calculate concentration results without the need for assayed reference materials. FP results can be further optimized and made fully quantitative with the use of a Matching Library. The intuitive and simple Rigaku software allows users to easily create a Matching Library to model their exact powders. One or more samples are assayed by a referee technique such as ICP and are considered type standards. The type standards are measured and registered in the library, which then adjusts the theoretical intensities and matches them to measured intensities of the known standards and the referee assay values, providing a fully quantitative optimized result.

Conclusion

This study illustrates how the NEX CG analyzer with secondary targets and the Rigaku RPF-SQX FP program yields excellent sensitivity and results for the elements of interest. The NEX CG offers the flexibility to reliably measure elements from Na to U and this versatility will allow the analyzer to adapt to the varying sample compositions and potential contaminant that may be encountered in the metal powders. The Rigaku NEX CG, with its high performance and simple yet advanced software, provides an easy-to-use and valuable tool for the metal 3D printing industry to ensure proper alloy mixtures and high quality metal parts.

Related products

NEX CG II Series

High-performance *indirect excitation* EDXRF for complex ap
plications with trace elements and variable base matrices