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PROJECT FINAL REPORT

Grant Agreement number: 277741

Project acronym: DATACAST

Project title: Development of a low cost Advanced gamma Titanium Aluminide Casting Technology

Funding Scheme: 36 months

Period covered: from 01.03.2011 to 28.02.2014

Name of the scientific representative of the project's co-ordinator[1], Title and Organisation:

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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

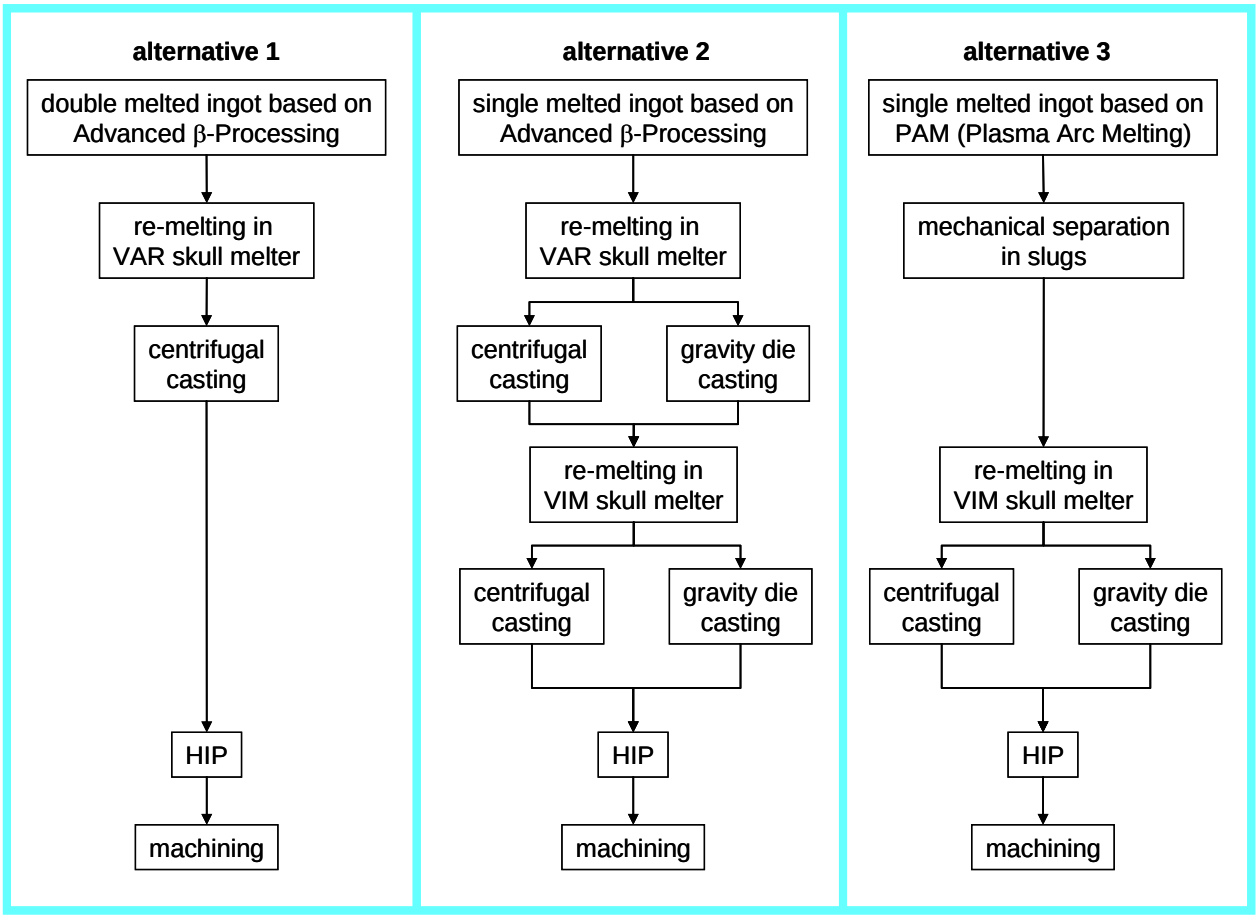


Figure 1: Technological alternatives of the entire production chain

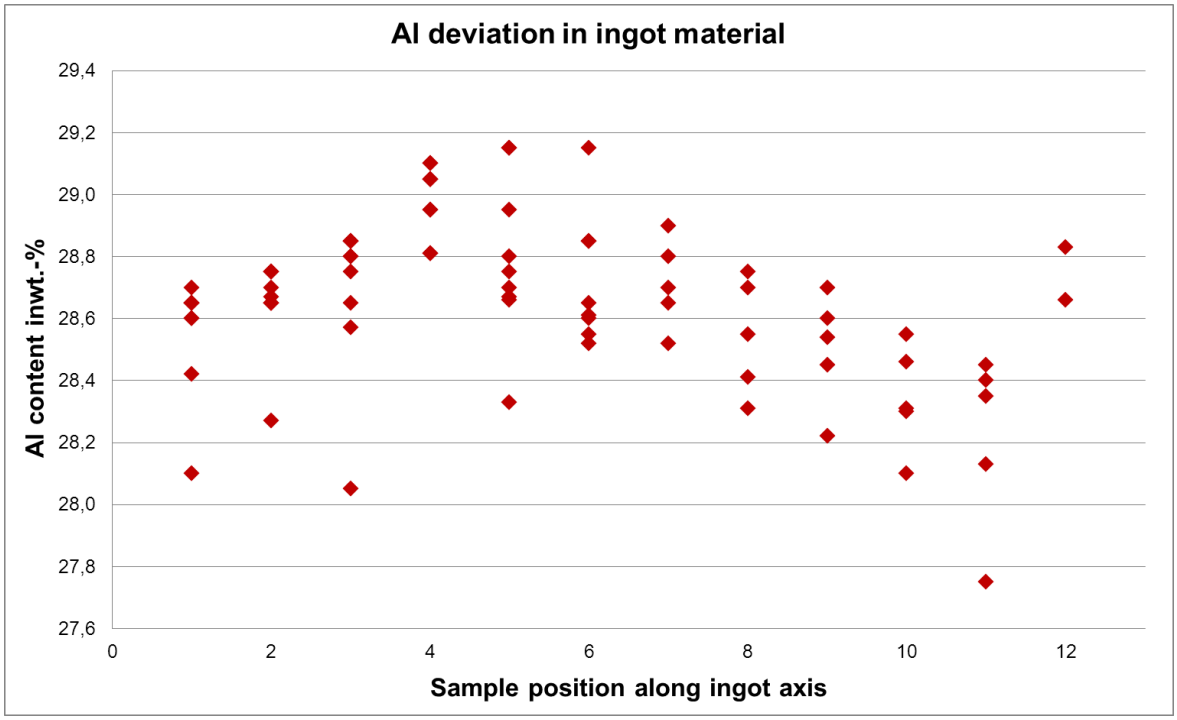


Figure 2: Local Al deviation of a double VAR melted TNM alloy ingot. Ingot size is 235 mm diameter and 1000 mm length. Dots indicate the local Al contents over the entire ingot. Al deviation has been determined to be +/- 0,7 at.-% which is quit homogeneous but not sufficient for TiAl materials.

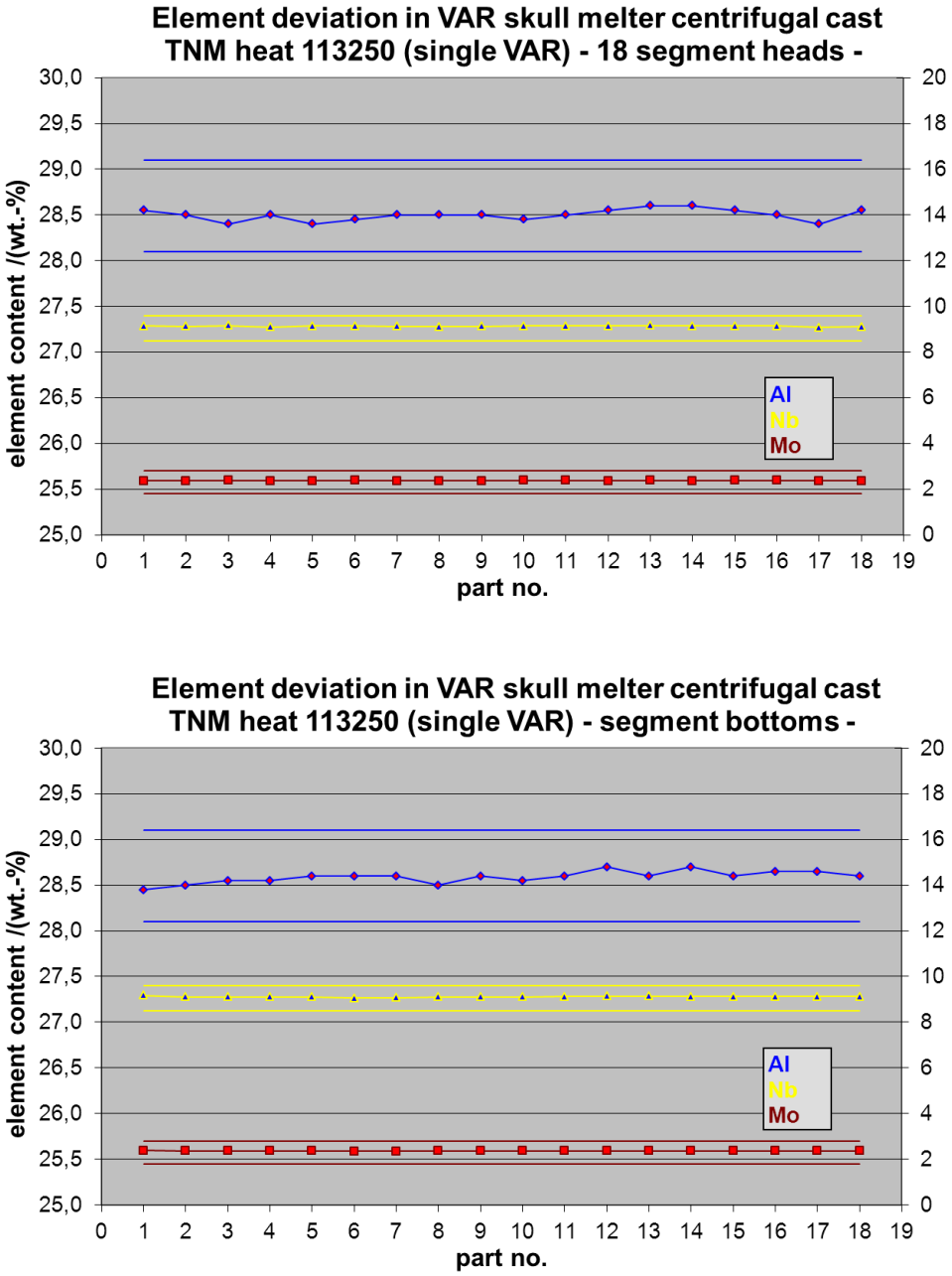


Figure 3: Determination of the chemical composition of one batch of cast cylindrical slugs in the VAR skull melter. The consumable electrode was single VAR melted

		Ti	Al	Nb	Mo	B	Fe	Cu	Ni	Si	C	O	H	N
nominal composition in at.-%		bal.	43,5 (42,8-44,2)	4,0 (3,7-4,3)	1,0 (0,8-1,2)	0,1 (0,05-0,15)								
real composition wt.-%		bal.	28,6	9,06	2,34	0,026	0,03	0,006	0,01	0,012	0,006	0,04	0,002	0,004
revert material wt-%		several batches with specified composition												
PAM wt.-%	a)	bal.	28,10	9,09	2,30	0,026	0,072	0,029	0,012	0,012	0,005	0,100	0,0010	0,005
	b)	bal.	28,15	9,25	2,25	0,029	0,056	0,043	0,012	0,015	0,009	0,084	0,0020	0,004
	mean value	bal.	28,13	9,17	2,28	0,028	0,064	0,036	0,012	0,014	0,007	0,092	0,0015	0,0045
PAM at.-% mean value		bal.	42,92	4,06	0,98	0,107								

Figure 4: Influence of PAM processing on the chemical composition of revert processed

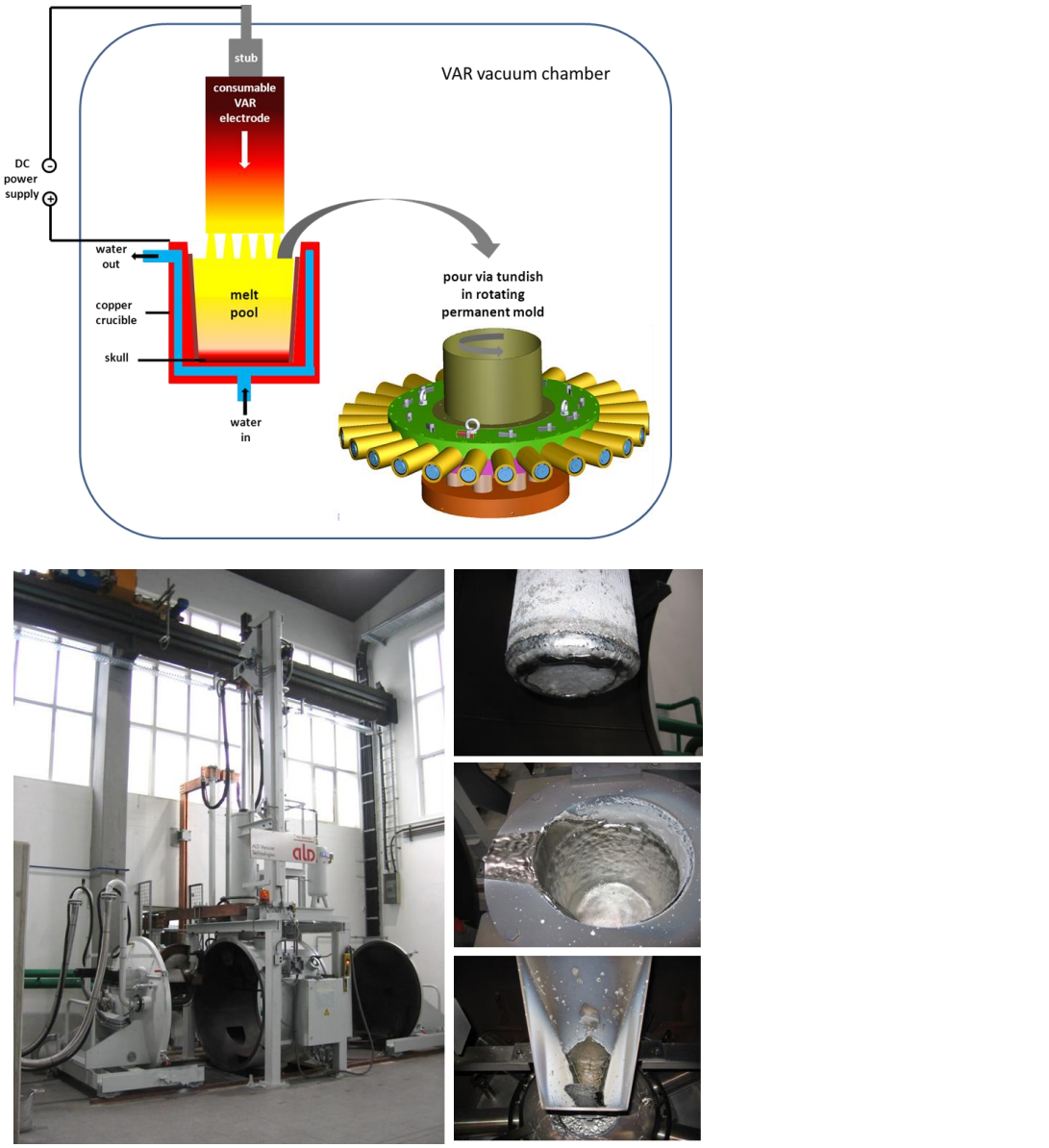


Figure 5: upper picture: Sketch of VAR SM processing

Lower picture: GfE VAR Skull Melter furnace (left), the remaining part of the consumable electrode (top right), the crucible including skull and pour lip (middle right) and the tundish on top of the casting wheel (bottom right)

Figure 6: Leicomelt casting facility at Access e.V.

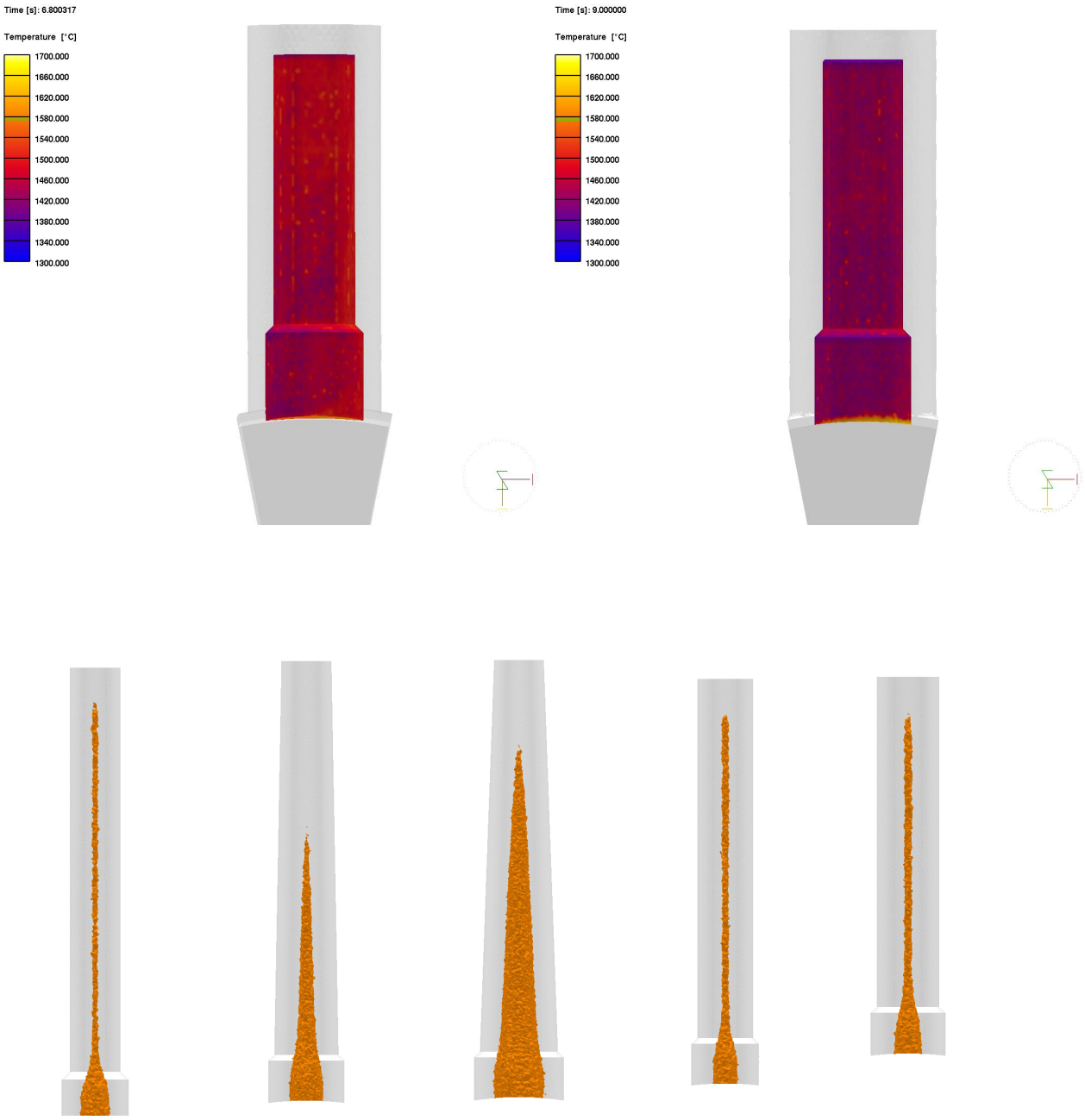


Figure 7: Simulation of solidification and the formation casting porosity in different moulds

heat 103959 - TNM

No.	Pos.	A-Nr.	Ti	Al	Nb	Mo
1	B	193560	59,45	28,90	9,03	2,32
2	B	193561	59,40	28,85	9,08	2,34
3	B	193562	59,45	28,85	9,07	2,34
4	B	193563	59,50	28,80	9,13	2,36
5	B	193564	59,45	28,85	9,02	2,32
6	B	193565	59,45	28,85	9,06	2,33
7	B	193566	59,40	28,85	9,06	2,34
8	B	193567	59,50	28,80	9,07	2,34
9	B	193568	59,55	28,85	9,05	2,33
10	B	193569	59,60	28,80	9,12	2,36
11	B	193570	59,55	28,80	9,10	2,35
12	B	193571	59,55	28,80	9,10	2,35
13	B	193572	59,55	28,80	9,11	2,35
14	B	193573	59,55	28,80	9,10	2,34
15	B	193574	59,55	28,80	9,11	2,35
16	B	193575	59,60	28,80	9,06	2,33
17	B	193576	59,55	28,85	9,07	2,33
18	B	193577	59,55	28,80	9,09	2,34
	AV		59,51	28,83	9,08	2,34
	Rel STD		0,10%	0,10%	0,33%	0,49%

heat 103959 - TNM

No.	Pos.	A-Nr.	Ti	Al	Nb	Mo
1	H	194159	59,55	28,80	9,11	2,35
2	H	193578	59,55	28,80	9,09	2,35
3	H	194160	59,55	28,80	9,12	2,35
4	H	194161	59,55	28,75	9,13	2,36
5	H	194162	59,60	28,75	9,12	2,35
6	H	194163	59,60	28,80	9,09	2,34
7	H	194164	59,55	28,75	9,14	2,36
8	H	194165	59,50	28,85	9,08	2,35
9	H	194166	59,50	28,85	9,07	2,34
10	H	193579	59,55	28,80	9,08	2,34
11	H	194167	59,50	28,85	9,09	2,35
12	H	193580	59,55	28,80	9,11	2,35
13	H	194168	59,50	28,90	9,08	2,34
14	H	194169	59,50	28,85	9,07	2,34
15	H	194170	59,55	28,85	9,08	2,35
16	H	194171	59,50	28,85	9,09	2,35
17	H	194172	59,50	28,85	9,08	2,34
18	H	193581	59,55	28,80	9,09	2,34
	AV		59,54	28,82	9,10	2,35
	Rel STD		0,05%	0,14%	0,22%	0,28%

Table 1: Results of the chemical analysis of 18 slugs (one pour) at the bottom (B) and top (H) of each slug

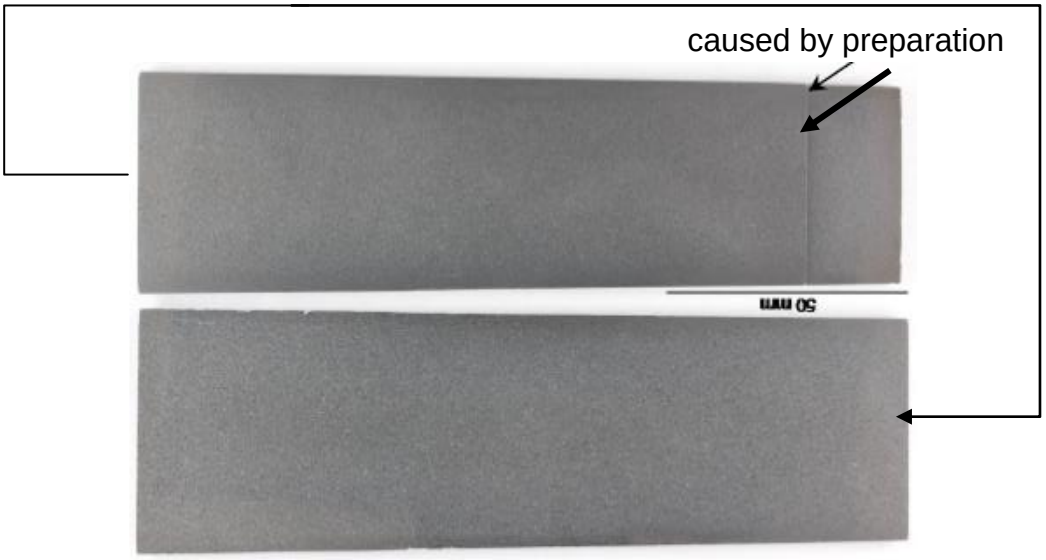
based on virgin materials	VAR SM	ISM
single VAR melted ingot	basically applicable, advanced β-processing required	limited to very small size
double VAR melted ingot	basically applicable, advanced β-processing required	applicable on advanced β-processing but to be mechanically cut into small sizes
PAM ingot	not applicable due to cracking phenomina	not applicable due to insufficient homogeneity

based on revert material	VAR SM	ISM
direct load	maximum 15 % of the batch size can consist of revert material	almost unlimited with Aluminum adjustment
PAM ingot	not applicable due to cracking phenomina	applicable but to be mechanically cut to small sizes
VAR SM ingot	not applicable due to cracking phenomina	applicable but to be mechanically cut to small sizes

General	VAR SM	ISM
batch size	up to several tons	limited to about 60 kg
melt overheat	more than 100 K	less than 100 K
evaporation of elements	effectively suppressed by the "shadow" of the consumable electrode	Al, Mn and Cr are being partly evaporated and have to be compensated
homogeneity of cast parts	excellent	excellent
specific energy consumption	high	very high
specific processing costs	medium	high

Table 2: Pro`s and Con`s of VAR SM vs. ISM

		Ti	Al	Nb	Mo	B	Cr	Cu	Fe	Ni	Si	Y	C	H	N	O
	min		28,1	8,5	1,8	0,019										
	max		29,1	9,6	2,8	0,034	0,050	0,150	0,060	0,020	0,050	0,001	0,020	0,005	0,015	0,080
Charge	145030A3	bal.	28,50	9,21	2,40	0,024	0,008	0,001	0,059	0,009	0,008	0,001	0,004	0,001	0,003	0,068
	146293A2	bal.	28,50	9,11	2,35	0,032	0,008	0,001	0,032	0,010	0,008	0,001	0,003	0,001	0,004	0,065
	146294A3	bal.	28,75	8,86	2,43	0,031	0,008	0,005	0,031	0,009	0,009	0,001	0,006	0,001	0,004	0,074
	146972A3	bal.	28,65	9,24	2,34	0,031	0,009	0,002	0,035	0,001	0,010	0,001	0,007	0,001	0,004	0,076
	146985A3	bal.	28,65	9,19	2,35	0,029	0,008	0,001	0,032	0,009	0,010	0,001	0,007	0,002	0,004	0,083



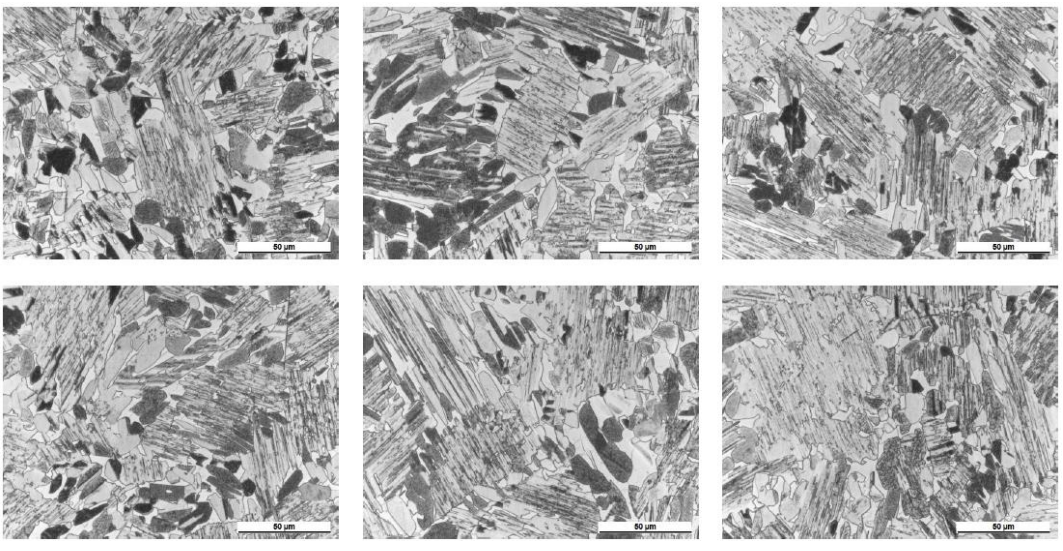


Figure 8: Chemical analysis, macrostructure and microstructure of production set 1

	Al	Nb	Mo	B	Fe	Cr	Cu	Si	C	H	N	O
146289A3	29	9,18	2,35	0,026	0,033	0,008	0,001	0,008	0,003	0,001	0,002	0,07
146292A3	28,6	9,19	2,4	0,03	0,03	0,008	0,001	0,007	0,003	0,001	0,003	0,065
146435A3	28,7	9,32	2,4	0,029	0,032	0,008	0,001	0,008	0,003	0,001	0,003	0,065
146440A3	28,5	9,16	2,22	0,032	0,035	0,008	0,001	0,008	0,004	0,004	0,005	0,077
146441A3	28,86	9,1	2,42	0,03	0,032	0,008	0,001	0,009	0,003	0,001	0,002	0,06

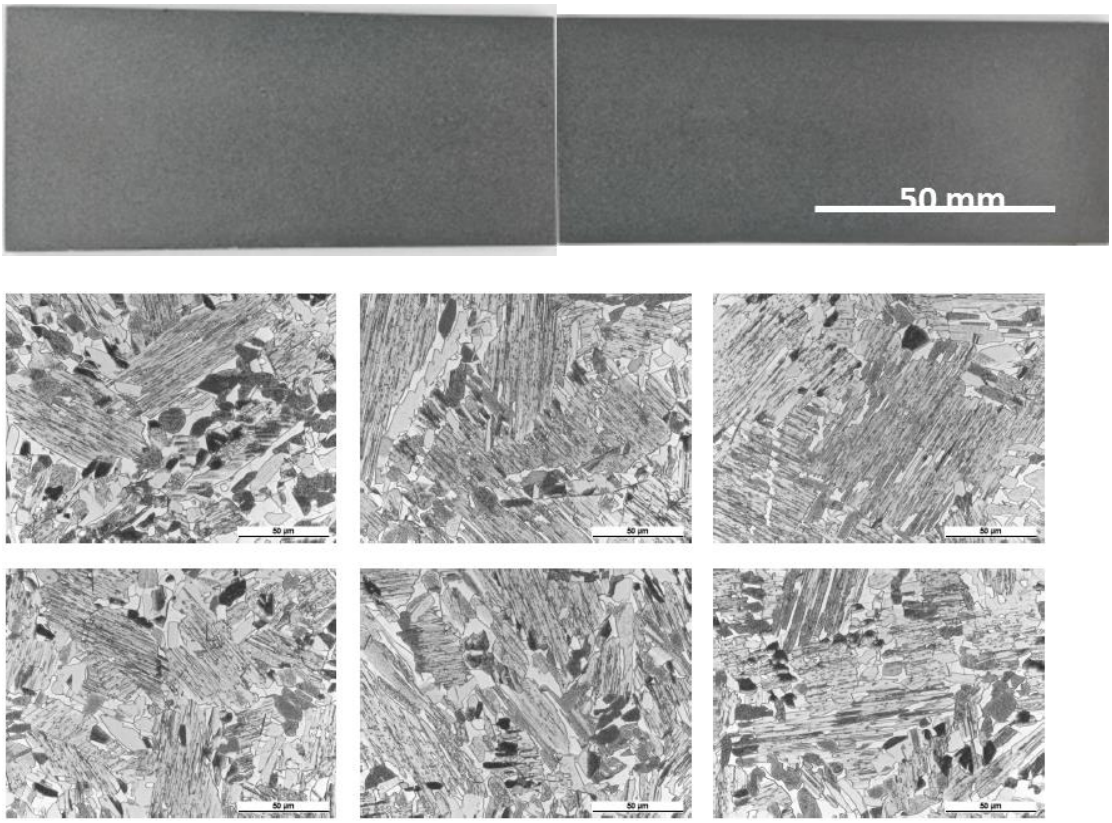


Figure 9: Chemical analysis, macrostructure and microstructure of production set 2