ESRF	**Experiment title:** Time–Resolved Studies of Self–Propagating High–Temperature Synthesis of Nickelaluminides	**Experiment number:** CH–490
Beamline: ID11	**Date of experiment:** from: Sept.25,1998 to: Sept. 30,1998	**Date of report:** Feb. 26,1999
Shifts: 15	**Local contact(s):** Åke Kvick	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Åke Kvick and Caroline Curfs, ESRF, Grenoble
M.A.Rodriguez and I.G.Cano,Instituto de Ceramico y Vidrico,Arganda del Rey,Madrid,Spain
X.Turillas, Instituto Edurado Torroja (CSIC), Madrid , Spain

Report:

Self–propagating high–temperature syntheses (SHS) were performed in the quarternary Al–Ti–Ni–C system. A total of 56 different compositions were investigated.Many of the compounds investigated have properties that make them attractive for many industrial applications.The Materials Science beamline ID11 was used to follow the in–situ reactions on a time–scale down to ~100millisecs. Powder diffraction patterns were recorded in this time–interval using a high speed Frelon CCD camera coupled to an image intensifier X–ray sensitive detector with pixel resolution of 100 microns.As the reaction proceeded patterns from the pre–heated, reaction front , post–heated and cooling portions of the reactions were sampled.The phases occurring during the reactions were identified and information of the reaction mechanisms and the nucleation characterization were obtained.SEM studies are now under way to characterize the microstructure.Table 1 gives a summary of the obtained results and Fig.1 gives an illustration of a typical powder pattern obtained.

Name	N. of exp.	composition % at. Al	Ni	Ti	C	theoretical compounds	Experimental compounds	Compounds found by microanalysis
AlNi1A 1B 1C	3 4 5	35.2	64.8			Al_3Ni_5	-	Ni-AlNi$_3$-Al$_2$Ni$_3$-Al$_3$Ni$_2$-Al$_{0.42}$Ni$_{0.58}$-Al$_x$Ni$_{2-x(x-1)}$
AlNi2A	1 2 56	50	50			NiAl	Ni-NiAl	Ni-NiAl-Al3Ni2-Al
AlNi3A	6	40.2	59.8			NiAl+Al_3Ni_5	Ni-NiAl	
AlNi4A	7	27.5	72.5			AlNi$_3$c	NiAl-AlNi$_3$c	Ni-AlNi$_3$-Al$_2$Ni$_3$-NiAl-Al
AlNi5A	8	25	75			AlNi$_3$c	Ni-NiAl-Al$_3$Ni$_2$-AlNi$_3$c	
AlNi6A 6B	9	55	45			NiAl	Ni-NiAl-Al$_3$Ni$_2$-Al-Al$_3$Ni$_5$	
AlNi7A	10	61.6	38.4			Al_3Ni_2	NiAl-Al$_3$Ni$_2$-Al-Al$_3$Ni-Al$_3$N$_{16}$	
AlNi8A 8B	11 12	68.5	31.5			Al_3Ni_2	Ni-NiAl-Al$_3$Ni$_2$-Al$_3$Ni	
AlNi9A	13	70	30			Al_3Ni	Ni-NiAl-Al$_3$Ni$_2$-Al-Al$_3$Ni	
AlNi10A	14	75	25			Al-Al_3Ni	-	
ANT1A 1CYL 1CYB 1E	44 52 53 54	27	50	33		H = $Al_{0.27}Ni_{0.50}Ti_{0.23}$ [1] = Ni_2AlTi [2]	H + compounds not identified	
ANT2A	45	20	75	5		γ=$Al_{0.20}Ni_{0.75}Ti_{0.05}$ [1]=$Ni_{13}Al$ [2]	γ-Tih-H	
ANT3A	-		50	50		TiNi+Ti_2Ni	-	
ANT4A	46		33.3	66.6		Ti_2Ni	-	
ANT5A 5B 5C	47 48 49	50		50		AlTi	Al-AlTi$_3$-AlTi-Tih	
ANT6A	50	75		25		Al_3Ti	-	
ANT7A	-	66.6		33.3		Al_2Ti	-	
ANT8A	51	25		75		AlTi$_3$	AlTi$_3$-Tic-Tih	
ANTC							NiAl-TiC + compounds not identified	

[1] J.F. Javel, M. Dirand, J.J Kuntz, F.Z. Nassik, J.C. Gachon, *J. Alloys and Compounds* 247 (1997) 72-81

[2] P. Nashand W.W. Liang, *Metall. trans. A.* 16(3) (1985) 319.

NB :For the samples which contain Al, Ni, Ti and C, we have found AlNi and TiC and other compounds not identified.
The major difference between each sample is the peak intensities of NiAl and TiC.

Table1: Theoretical and experimental results of the synthesis of NiAl/TiC composite

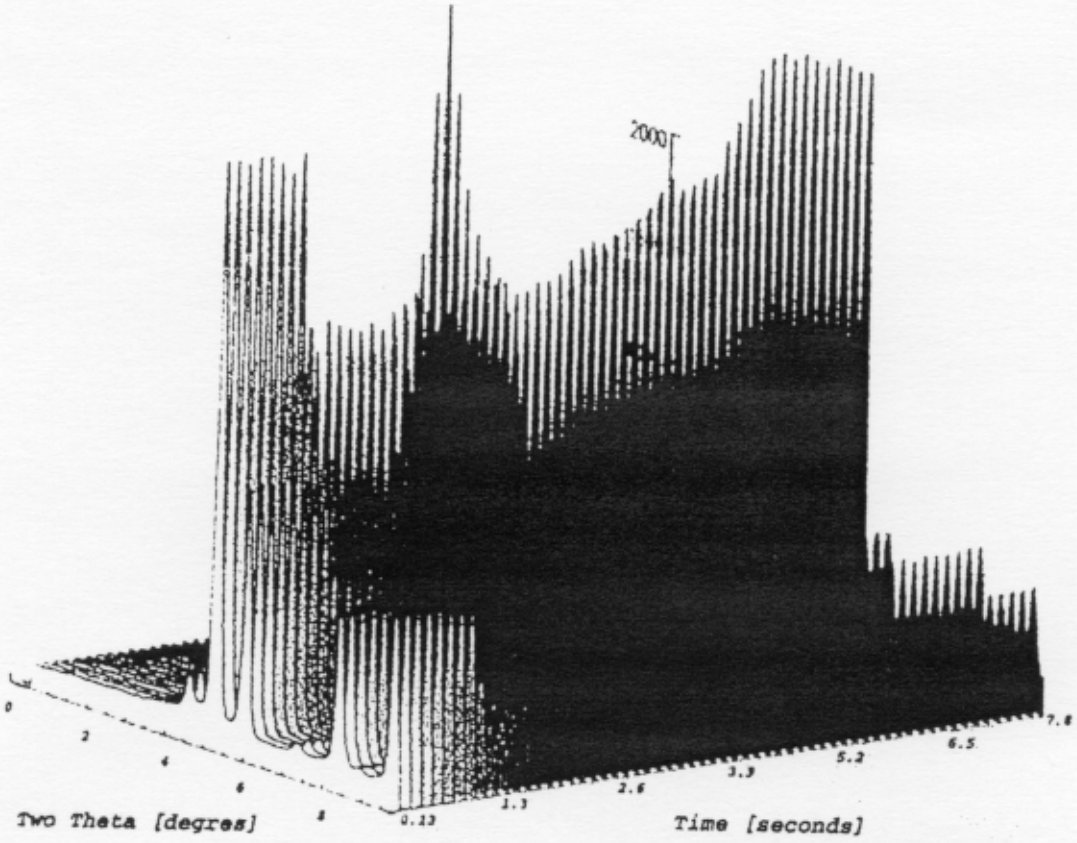

Fig 1: synthesis of Ni-Al alloy (Al=27.5 at.%, Ni=72.5 at. %)