Possible New Superconductors in Al-B and RE-Si_5 using High Pressure - High Temperature

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AFOSR MURI "SEARCH FOR NEW SUPERCONDUCTORS FOR ENERGY AND POWER APPLICATIONS"

1 Introduction:

❖ Search for SC in the $RESi_5$ ($CeSi_5$, $PrSi_5$ & $NdSi_5$) and Al-B systems .

❖ $LaSi_5$ showed new SC. (T_C=11.5 K) , *S. Yamanaka at al. J. Solid State Chem., 182 , (2009).*

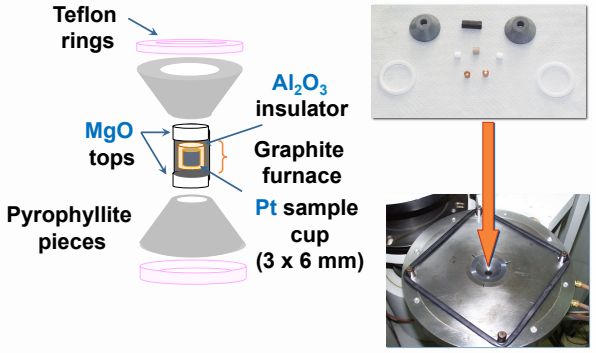
❖ $Al_{0.67}B_2$: the MgB_2 analog.

❖ Synthesize AlB_2 off stoichiometry.

Investigated Systems

	Arc Melting	HP-HT	Thin Film
La-Si-C	✓		✓
La-Si-B	✓		
Ce-Si-C	✓		
Ce-Si-C	✓		
Pr-Si-C	✓		
Pr-Si-B	✓		
Nd-Si-C		✓	
Nd-Si-B		✓	
Eu-Si-C			
Eu-Si-B			
Gd-Si-C		✓	
Gd-Si-B		✓	
$CeSi_5$		✓	
$PrSi_5$		✓	
$NdPr_5$		✓	
Al-B	✓	✓	✓
La-Ba-Fe-Si	✓		✓
V-Si-C			✓

2 HIGH PRESSURE-HIGH TEMP (HP-HT)

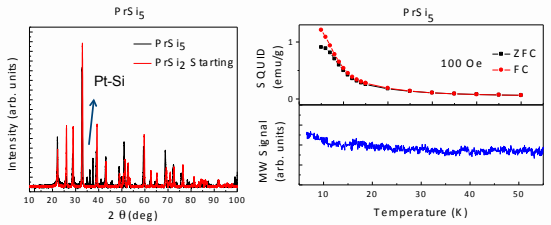


❖ Up to 80 Kbar and 1400°C.

3 $CeSi_5$, $PrSi_5$ and $NdSi_5$

80 Kbar ; 1100°C; 30 min

$RESi_2$ (arc melted) + Si → $RESi_5$

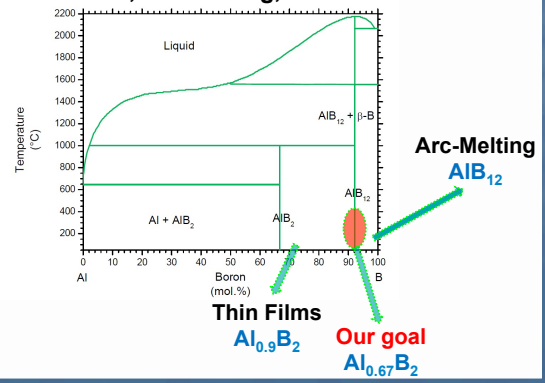


❖ No SC.
❖ No formation of $RESi_5$ compounds.

4 $Al_{0.67}B_2$: the MgB_2 analog

$Al_{0.67}B_2$ off stoichiometry:

HP-HT, Arc-Melting, and thin films.

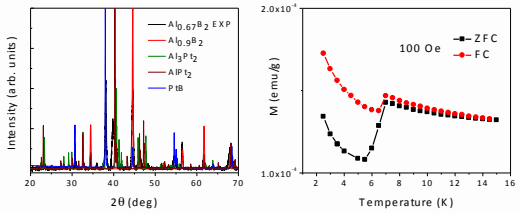


5 $Al_{0.67}B_2$

60 Kbar ; 1000°C; 30 min

AlB_2 + B → $Al_{0.67}B_2$

SC at 7 K



❖ Intermetallic compounds: capsule reaction.
❖ None of them could explain the SC.

6 Conclusions:

❖ HP-HT :unique technique for searching for new SC.

❖ $RESi_5$ using HP-HT : NO SC.

❖ AlB_2 shows promising results: the origin of the SC should be clarified.

Future Work:

❖ Prevent capsule reaction.

❖ New materials, different parameters.

❖Explore intensively the AlB_2 system in thin film form taking advantage of the MFMMS.