

FACTORS AFFECTING HYDROGEN RELEASE FROM LITHIUM ALANATE

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Experimental Program:

- Study release of hydrogen from different batches of LiAlH_4
- Add TiCl_3 and NaAlH_4
- Use different temperature ramp rates and pressures

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Hydrogen Release from undoped LiAlH_4



[$T_1 = 150\text{-}175^\circ\text{C}$, 5.3 wt%]



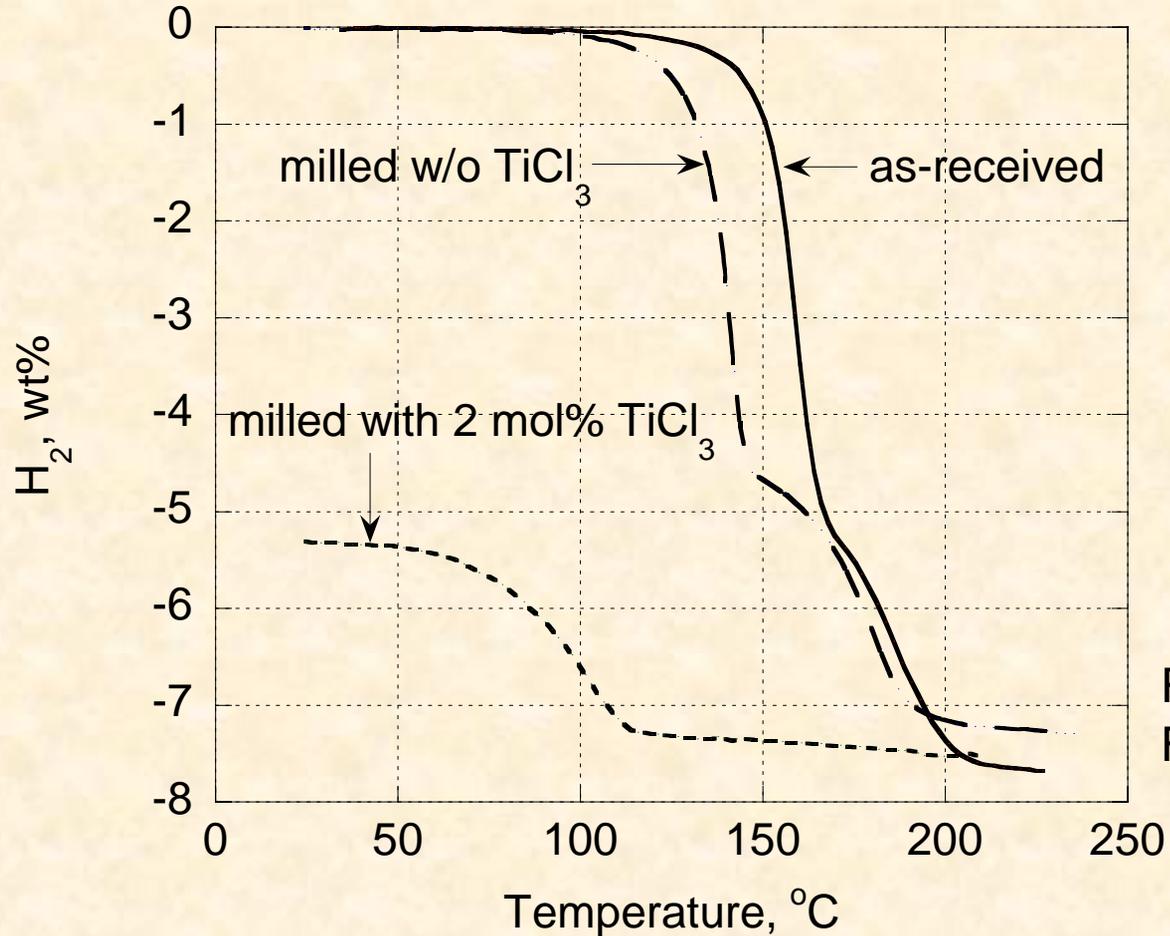
[$T_2 = 180\text{-}220^\circ\text{C}$, 2.6 wt%]



[$T_3 = 400^\circ\text{C}$, 2.6 wt%]

Thermal Programmed Desorption, Batch 1

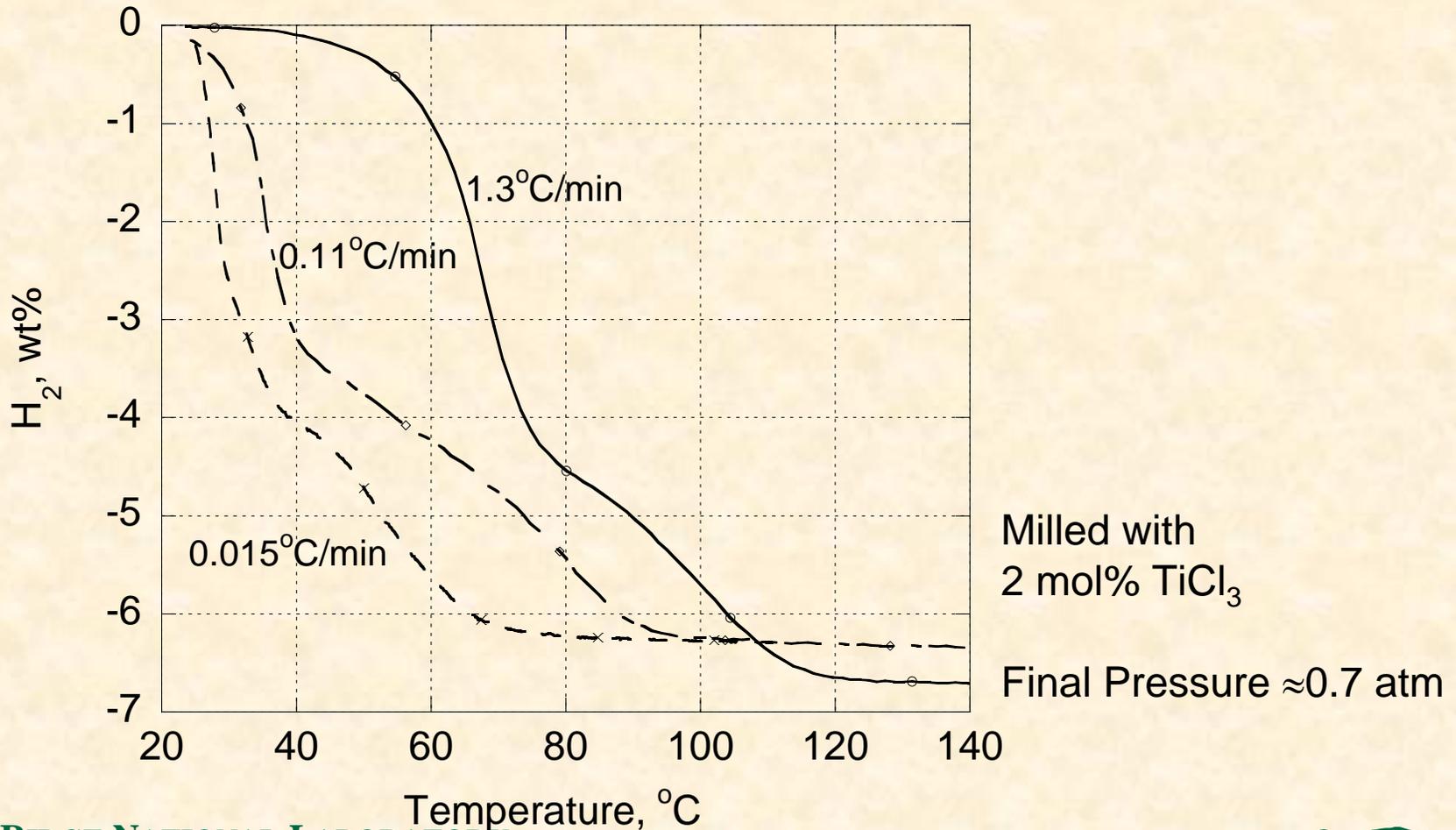
Reaction 1 complete after milling with TiCl_3



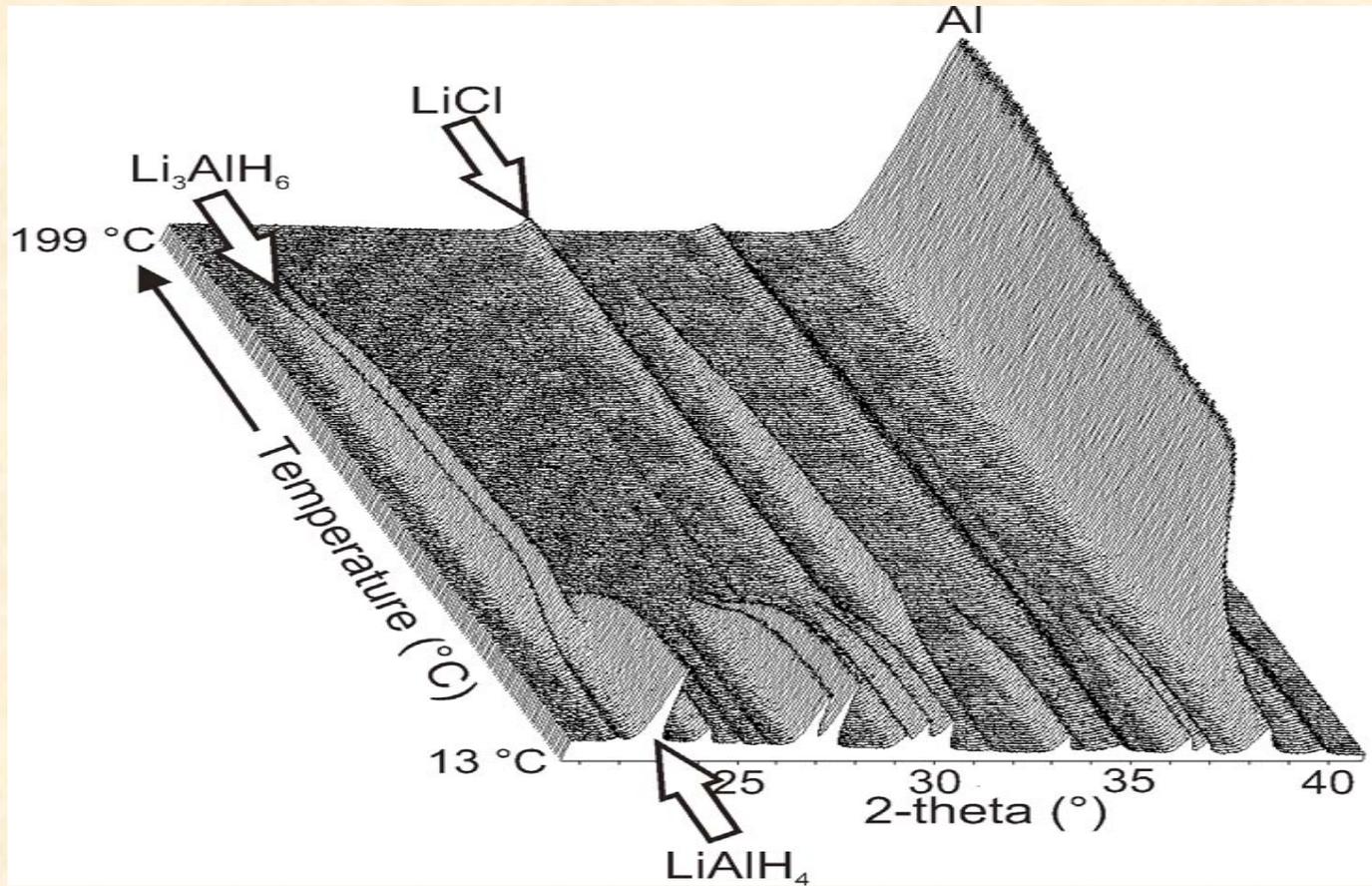
Ramp Rate $1.3^\circ\text{C}/\text{min}$
Final Pressure ≈ 0.7 atm

Thermal Programmed Desorption, Batch 2

Reaction 1 is observed after milling with TiCl_3



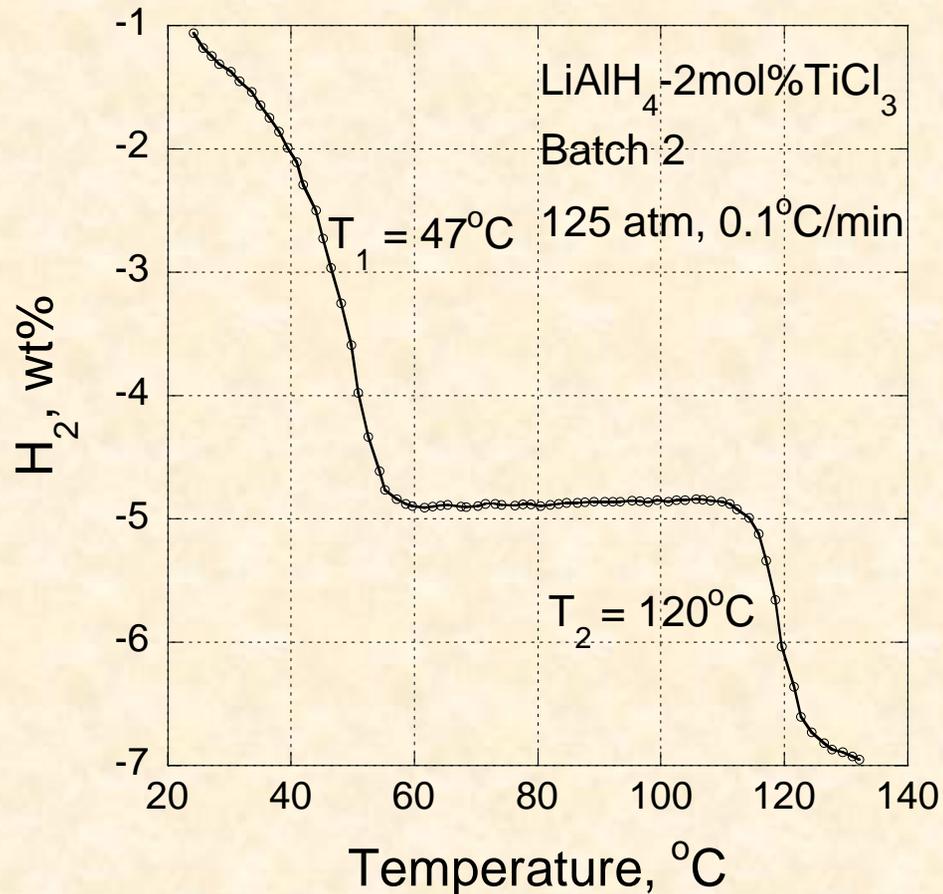
Decomposition of milled $\text{LiAlH}_4\text{-TiCl}_3$ at $0.1^\circ\text{C}/\text{min}$ - in-situ x-ray diffraction -



Decomposition Temperatures of milled Lithium Alanate

Batch	Composition, mol%	Ramp Rate (°C/min)	T ₁ (°C/min)	T ₂ (°C/min)
1	LiAlH ₄	1.3	140	180
1	LiAlH ₄ -2TiCl ₃	1.3	≤ 20?	94
1	LiAlH ₄ -2NaAlH ₄ -2TiCl ₃	1.3	65	101
2	LiAlH ₄ -2TiCl ₃	1.3	67	97
2	LiAlH ₄ -2TiCl ₃	0.11	37	77
2	LiAlH ₄ -2TiCl ₃	0.015	29	54

T_1 does not respond to pressure, T_2 does
No recharging at pressures up to 200 atm



Conclusions

- Batch-to-batch variations in the decomposition temperatures of LiAlH_4
- Doping with TiCl_3 reduces decomposition temperatures
- Decomposition temperature for reaction 1 may be below 20°C
- Doping with NaAlH_4 increases decomposition temperatures
- Decomposition temperatures not or only weakly pressure-dependent
- No recharging at pressures up to 200 atm

References:

- S. A. Speakman, J. H. Schneibel, D. S. Easton, „An In Situ X-ray Diffraction Study of the Desorption of TiCl_3 -Doped Sodium Alanate,” MRS Symp. Proc. 837, 2004, paper N3.3
- D. S. Easton, J. H. Schneibel, S. A. Speakman, „Factors affecting Hydrogen Release from Lithium Alanate (LiAlH_4),“ J. Alloys and Compounds 398 (2005) 245-248