Stationary Storage of Hydrogen: Modified Titanium Based Alloys

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Why Metal Hydrides

Hydrogen storage utilizing hydride technology offers several benefits over conventional technology:

- ***High Volumetric Energy Density / Compact***
- ***Low Pressure Operation***
- ***Refilling at low pressure from electrolysers or gaseous H_2 with no need for high pressure compressor***
- ***Use of waste heat from fuel cell or H_2 engine can reduce system cooling***

Why Stationary

Storage requirements for stationary applications are typically less stringent than those for storage on board a vehicle.

Stationary Storage of Hydrogen

Large-scale hydrogen storage

Heat pumps, compressors and refrigerators

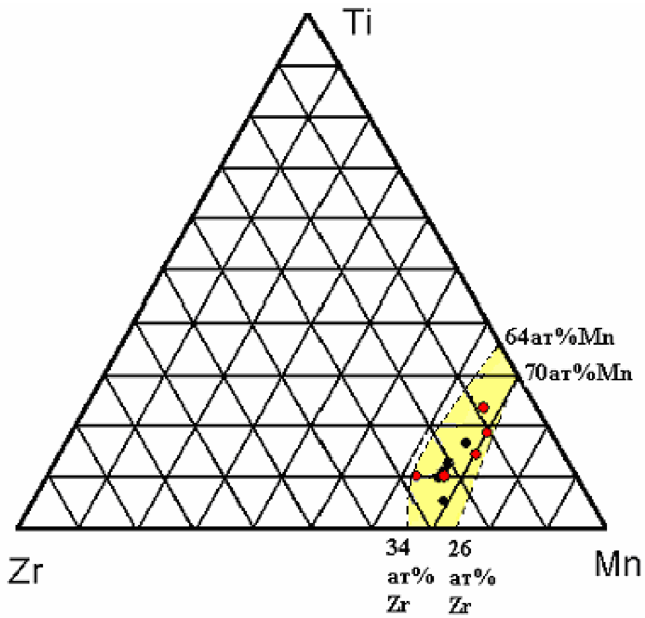
Hydrogen recovery and purification

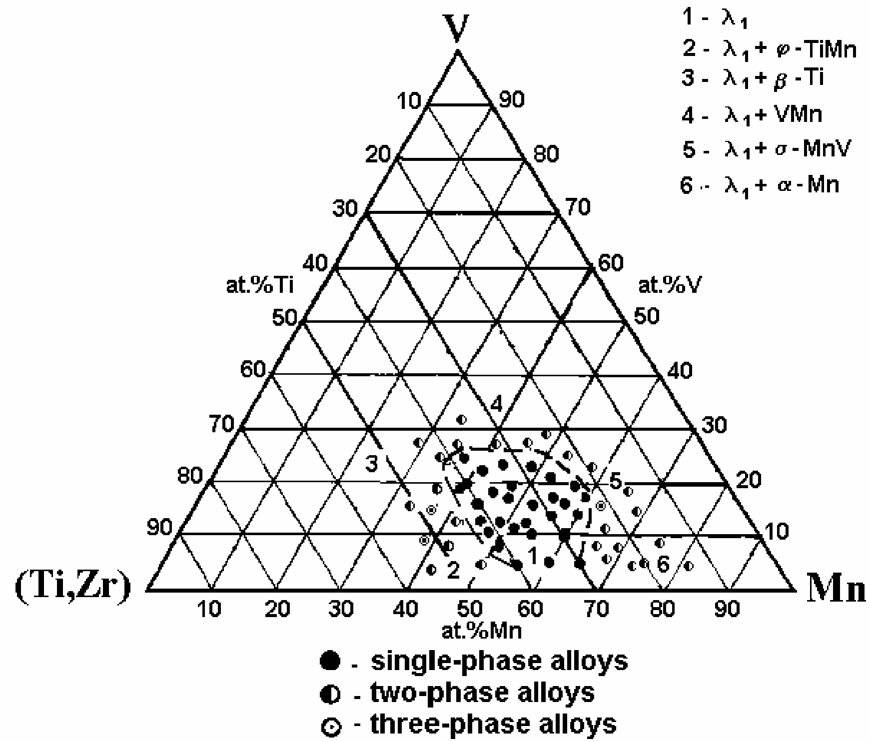
Laboratory storage systems

International Partnership for the Hydrogen Economy

Int'l H_2 Storage Technologies Conference

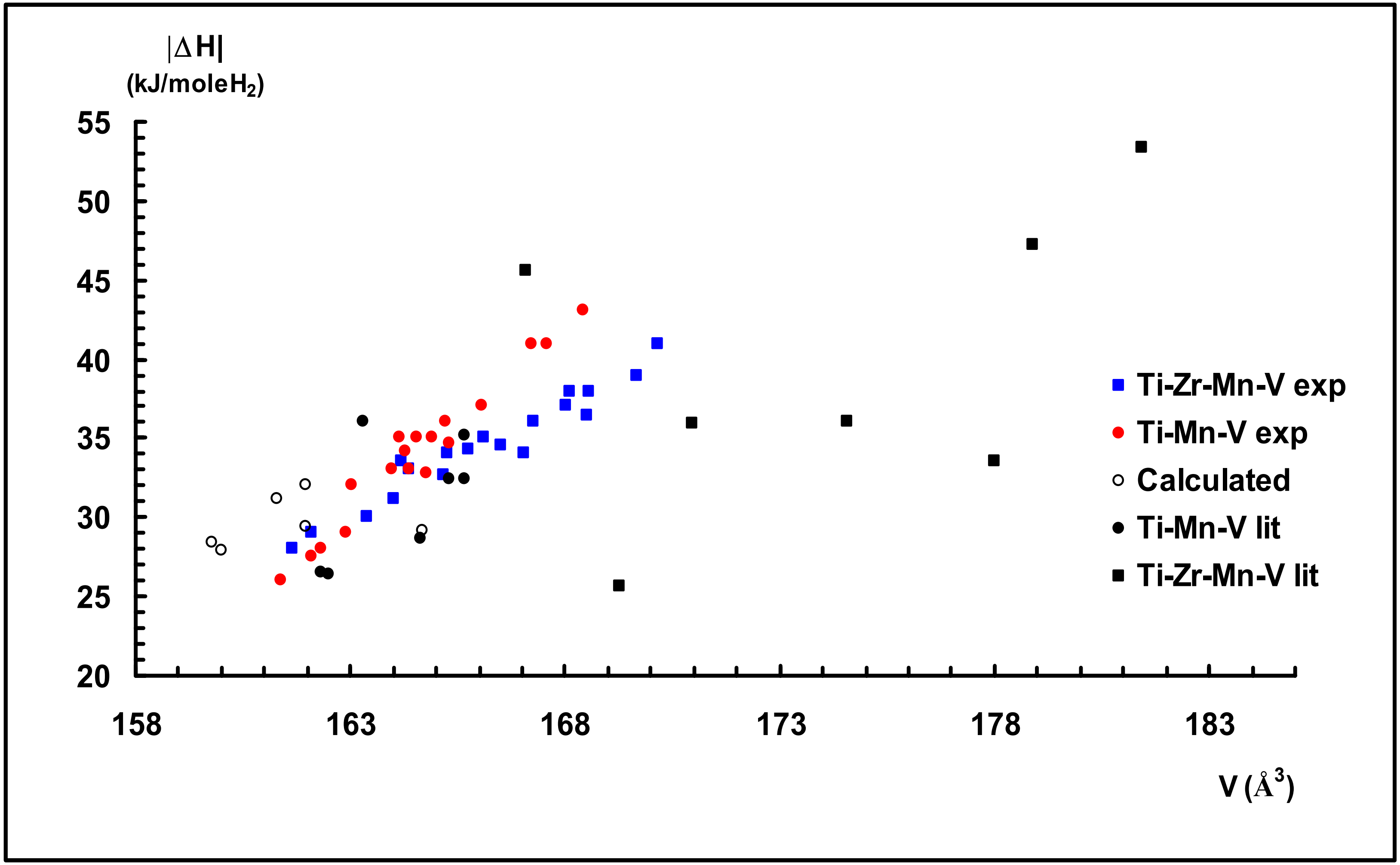
Laves Phase Homogeneity Ranges



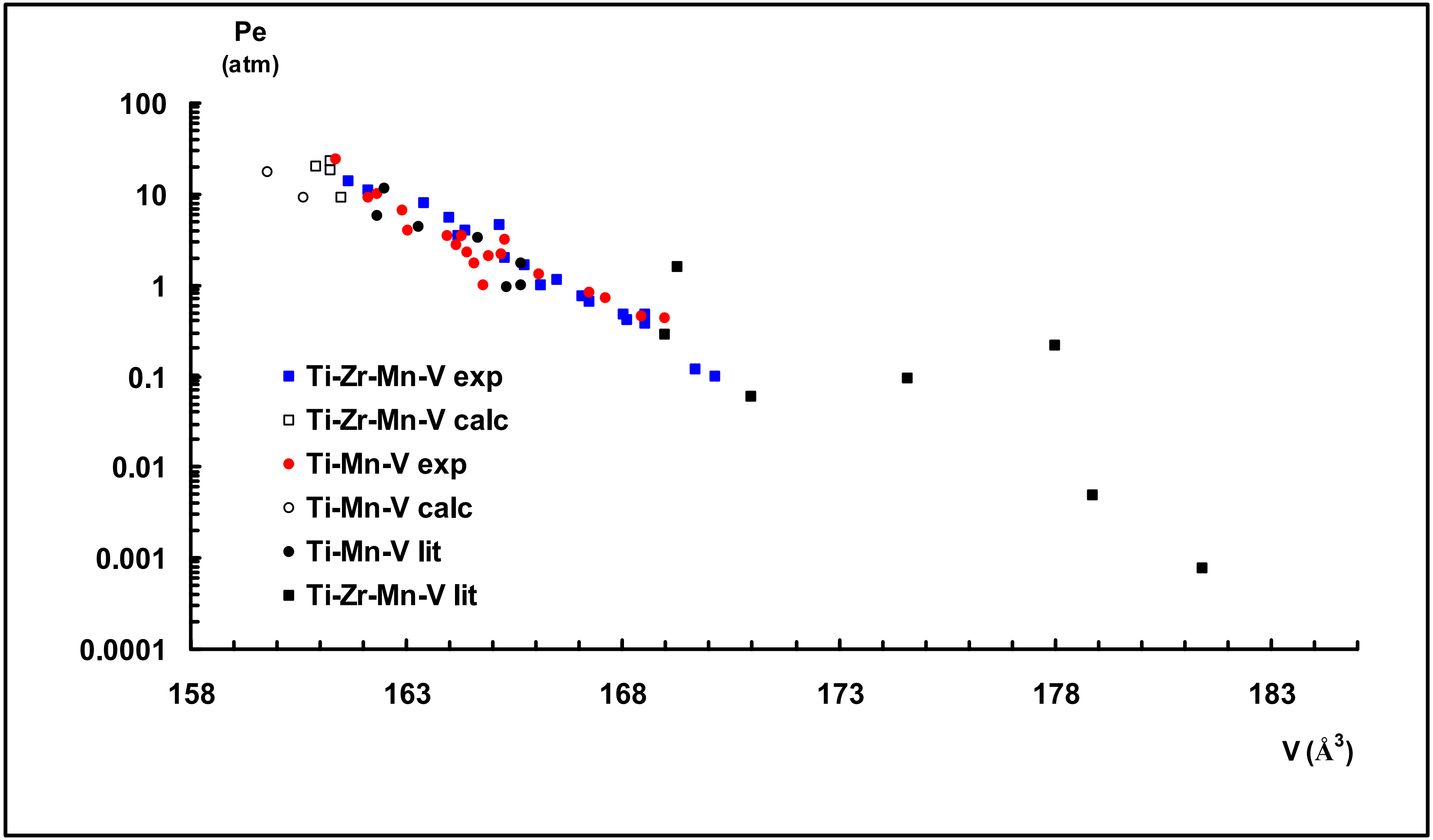


Int'l H_2 Storage Technologies Conference

Desorption enthalpy vs. Cell volume



Desorption pressure vs. Cell volume



Modelling of New Alloys

For binary system prediction is easy

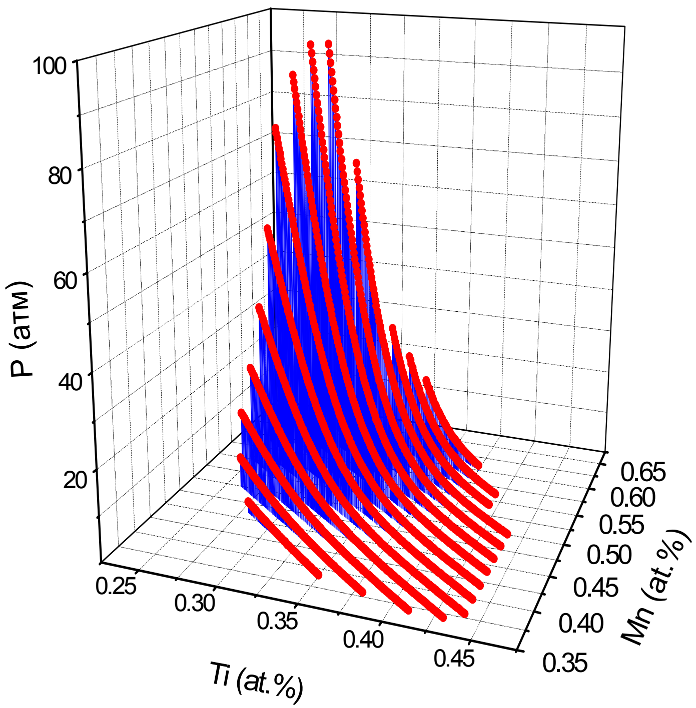
For multicomponent system prediction is difficult – concentrations of metals change all together

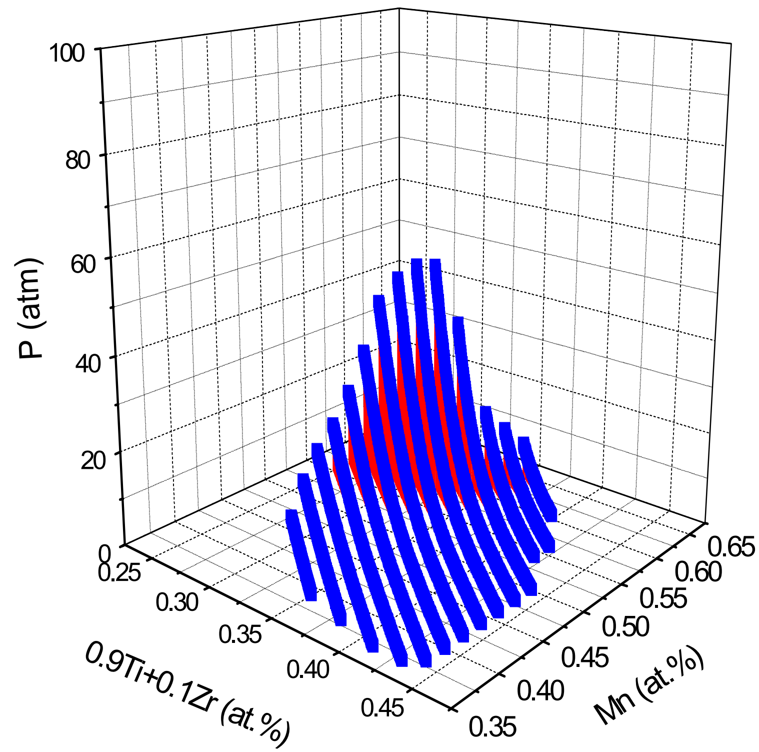
- In solid solutions ΔH, ΔS, lattice parameters change monotonously
- First approximation - full second power polynom
- $f(C) = A_0 + \Sigma A_i C_i + \Sigma A_{ij} C_i C_j$

Examples of Calculated and Experimental Parameters

Alloy	ΔH_{calc}	ΔH_{exp}	ΔS_{calc}	ΔS_{exp}	P_{calc} (atm) 293 K	P_{exp} (atm) 293 K
$TiMn_{1.25}V_{0.5}$	36.4	37.0	124.0	117.9	1.1	1.3
$TiMn_{1.4}V_{0.7}$	34.2	34.6	123.5	113.0	2.5	3.1
$Ti_{0.9}Zr_{0.1}Mn_{1.3}V_{0.4}$	40.1	41.2	120.0	121.4	0.1	0.1
$Ti_{0.9}Zr_{0.1}Mn_{1.6}V_{0.4}$	30.0	32.7	116.5	125.9	6.1	4.5

Calculated equilibrium pressures for Ti-Mn-V and Ti(Zr)-Mn-V Laves phase alloys





Collaboration – Past, Present and Future

These works were done for several years in collaboration with France, Switzerland, Austria, USA,

Now we are ready for collaboration in two directions

Research of materials for hydrogen storage at super high gaseous hydrogen pressure (3000 bar)

Research of materials for hydrogen storage at high hydrostatic pressure.