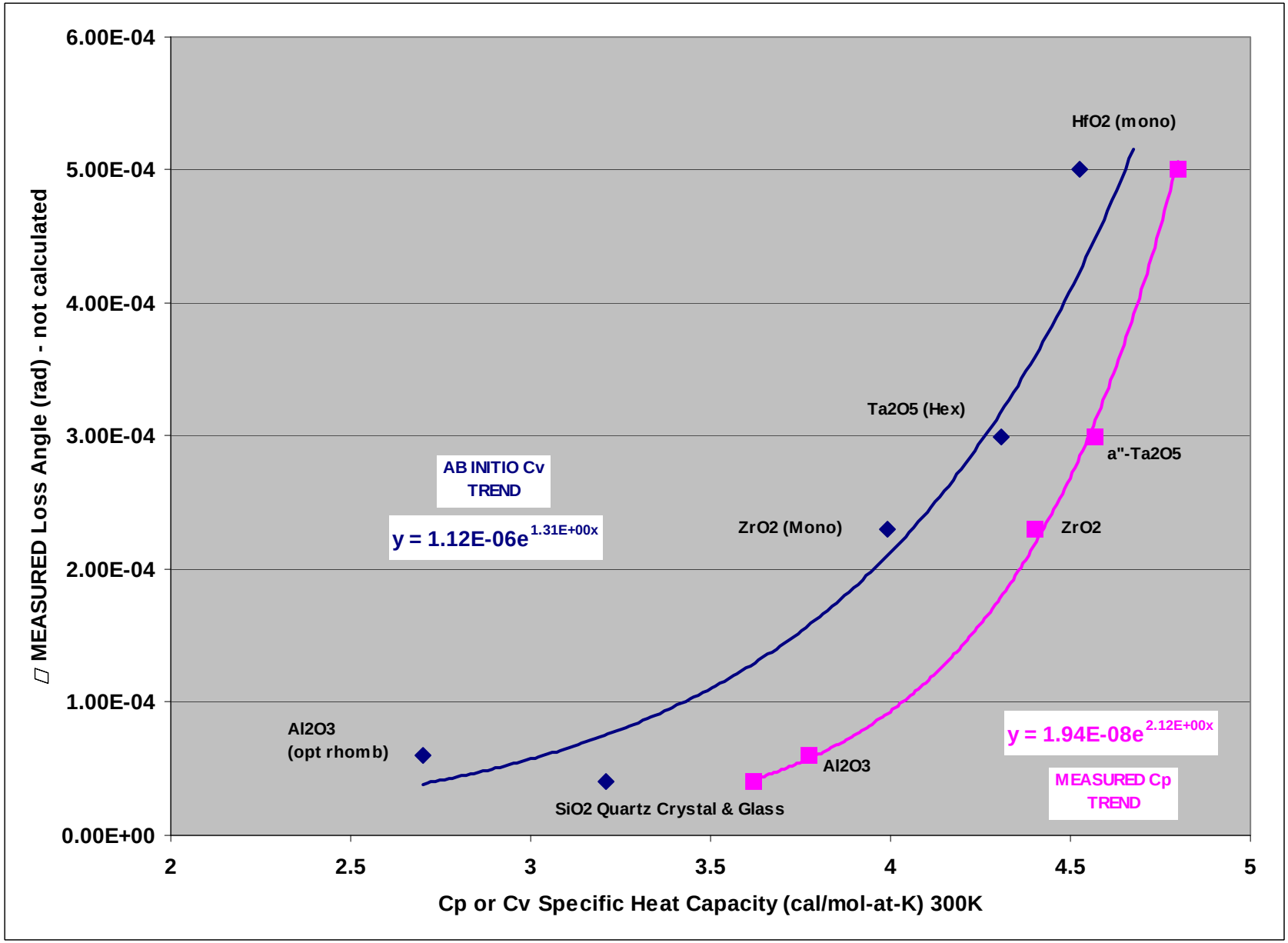
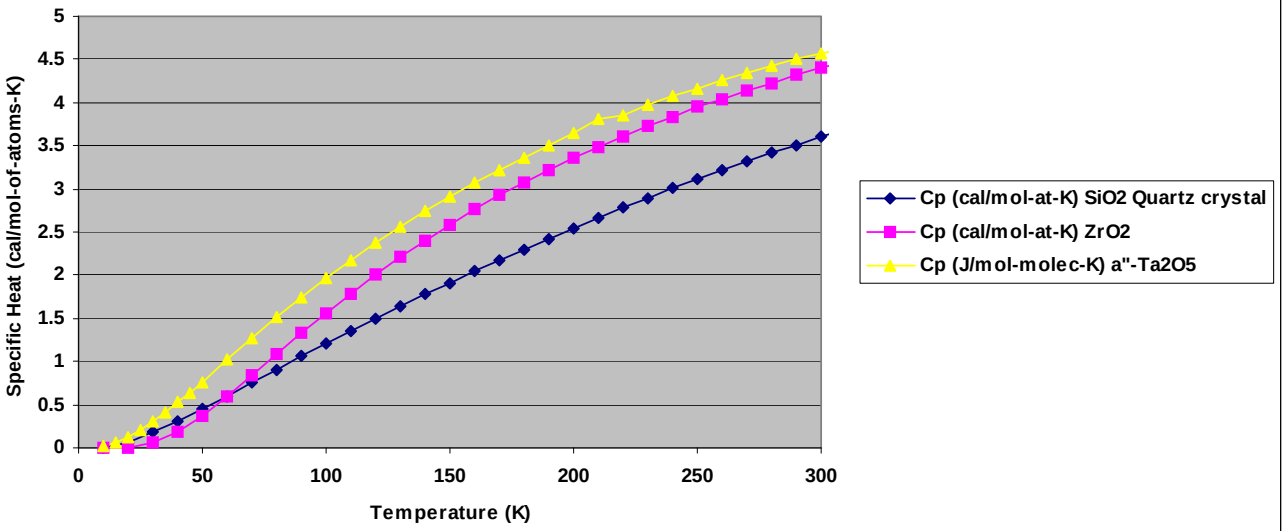
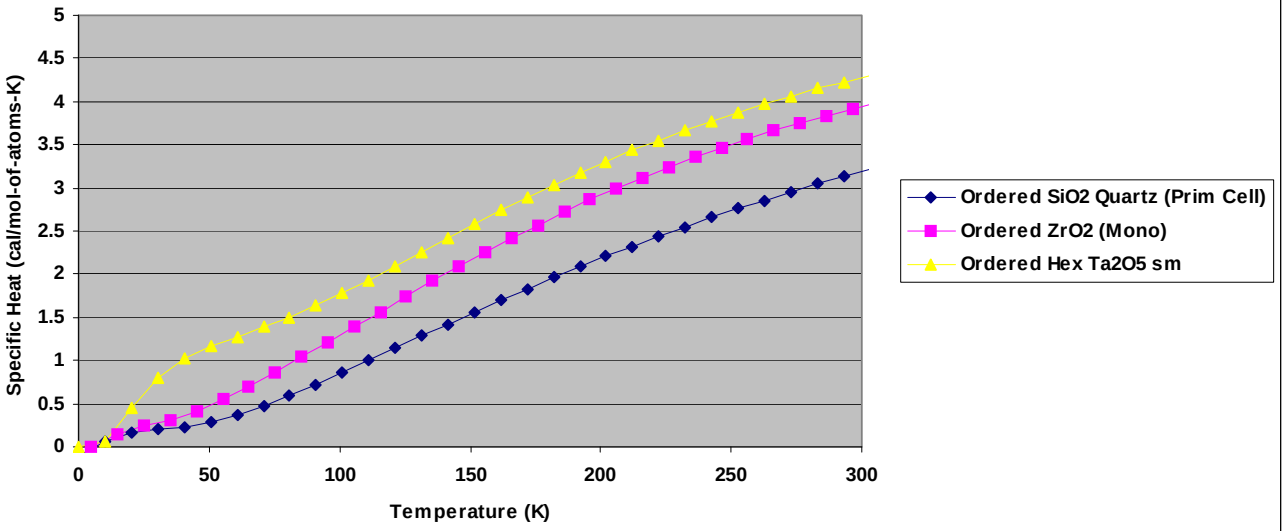
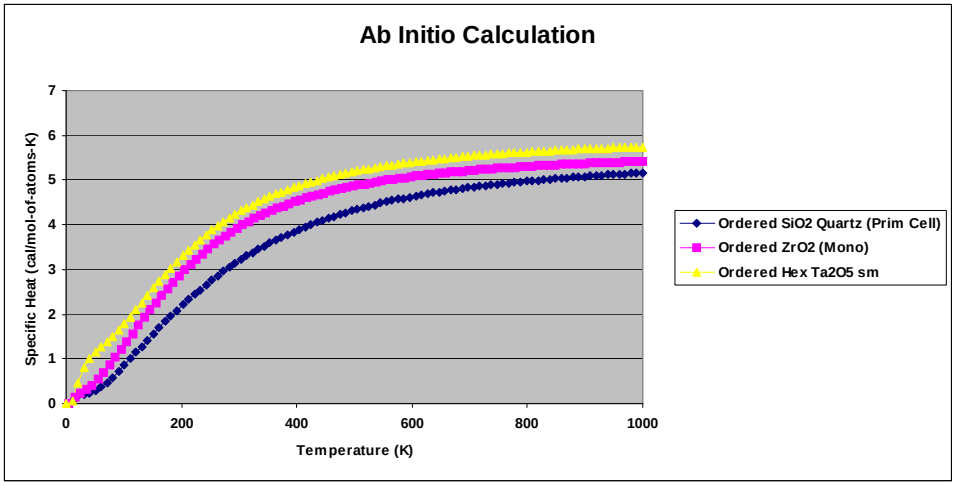

6.00E-04
5.00E-04
4.00E-04
3.00E-04
2.00E-04
1.00E-04
0.00E+00
▱ MEASURED Loss Angle (rad) - not calculated
2
2.5
3
3.5
4
4.5
5
Cp or Cv Specific Heat Capacity (cal/mol-at-K) 300K
HfO2 (mono)
Ta2O5 (Hex)
a"-Ta2O5
ZrO2 (Mono)
ZrO2
AB INITIO Cv TREND
y = 1.12E-06e^1.31E+00x
Al2O3 (opt rhomb)
SiO2 Quartz Crystal & Glass
Al2O3
y = 1.94E-08e^2.12E+00x
MEASURED Cp TREND

Measured Values from Literature

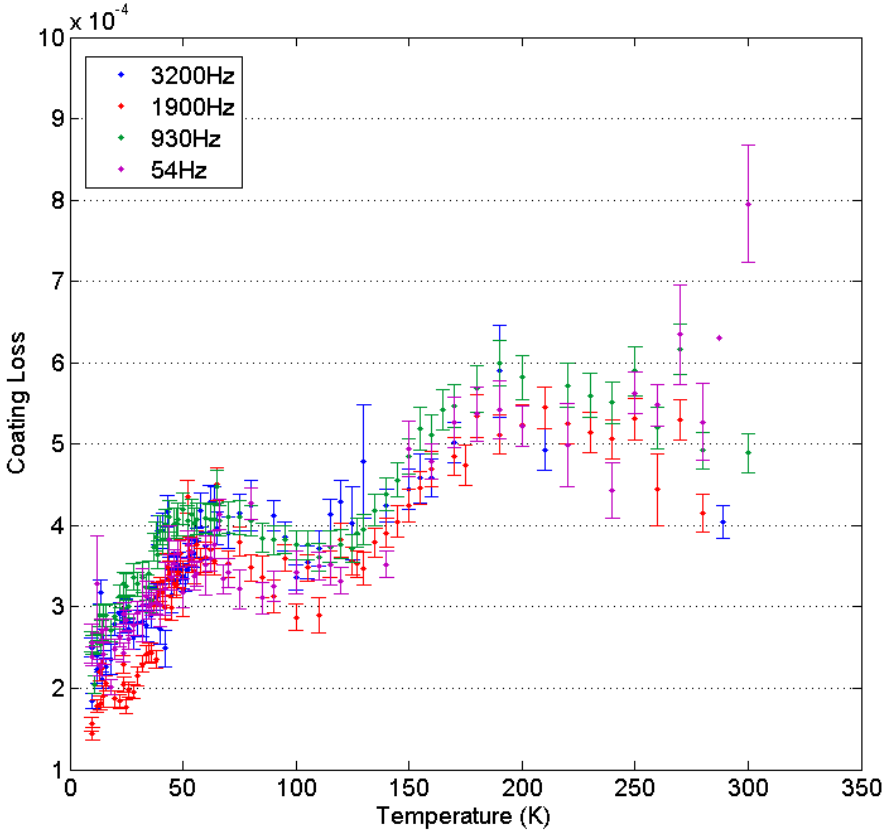


Ab Initio Calculation





Loss angle and
per-mole-of-atom specific heat capacity
look a lot alike,
in as far as temperature.



Nawrodt Hafnia Curve

Where I got data.

Coating material	Absorption (ppm)	Mechanical losses
Ta_2O_5	0.5	$\Phi_{Ta_2O_5} = 3.0 \cdot 10^{-4}$
Ta_2O_5 : W	2.45	$\Phi_{Ta_2O_5:W} = 7.5 \cdot 10^{-4}$ *
Ta_2O_5 : W+Ti	1.65	$\Phi_{Ta_2O_5:W+Ti} = 3.2 \cdot 10^{-4}$
Ta_2O_5 : Co	5000	$\Phi_{Ta_2O_5:Co} = 1.1 \cdot 10^{-3}$ *
ZrO_2	11	$\Phi_{ZrO_2} = 2.3 \cdot 10^{-4}$
ZrO_2 : Ti	37	$\Phi_{ZrO_2:Ti} = 6.8 \cdot 10^{-4}$
ZrO_2 : W	10	$\Phi_{ZrO_2:W} = 2.8 \cdot 10^{-4}$

Table 1: optical absorption and mechanical loss of various coating materials (coating thickness 500nm, * indicates before annealing)

Found on the internet, but the data comes from Glasgow.

- HfO2 loss angle 300K from Nawrodt Hafnia presentation ~ 5E-4.
- Al2O3 loss angle 6E-5 from Yamamoto talk, called Glasgow Ta2O5 / Al2O3. Yamamoto value is 4E-4, off trend !
- sapphire Al2O3 Cp 300K from J. Nuc. Sci. Tech 7 [6] 312-316 and also TA Instruments Data Sheet.
- SiO2 coating loss angle 300K from several places in DCC ~ 5E-5.
- HfO2 monoclinic 300K Cp from J. Ceram. Soc. 89 12 3751-3578 (2006).
- a”-Ta2O5 Cp function from J. Russian Phys. Chem. 61 (2) 361-365 (1987).
- SiO2, ZrO2 Cp function from Latin American Applied Research 34 257-265 (2004).
- Ab initio code for phonon calculations provided by Accelrys, $150K worth of code on a temp license. CASTEP, all GGA-PW91 functional.
- Accelrys also pointed out that Cv output is per cell and needs to be divided by atoms per cell – trend then obvious.