

Thermo-mechanical analysis: from calorimetric measurements to dynamic thermomechanical characterization for a complete investigation of microstructure and functional properties of materials

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Analisi calorimetrica



TA Q100
[-150°C ↔ 400°C]
MDSC



TA Q600
[25°C ↔ 1500°C]
Ar, Aria, N



Seiko 220C e TG/DTA Seiko 2000
[-100°C ↔ 750°C]
[25°C ↔ 1100°C]
Ar, Aria

Analisi meccanica e Dinamo- meccanica

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MTS 2/M
[-70°C ↔ 300°C]
100N, 2KN e 10KN
Trazione,
compressione,
flessione a due
punti, three point
bending



TA Q800
[-150°C ↔ 600°C]
18N
0.01-200 Hz
Trazione, single e
dual cantilever,
three point
bending,
compressione

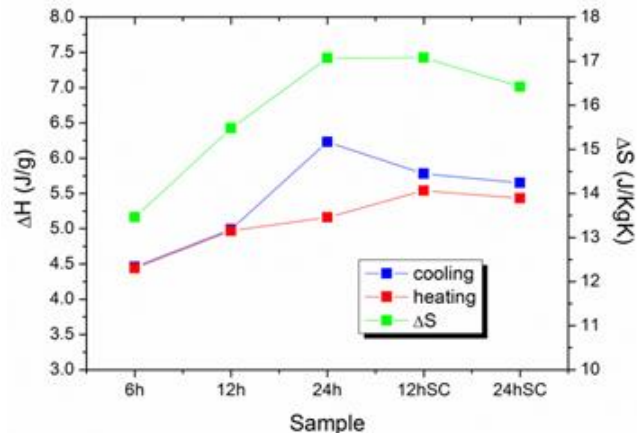
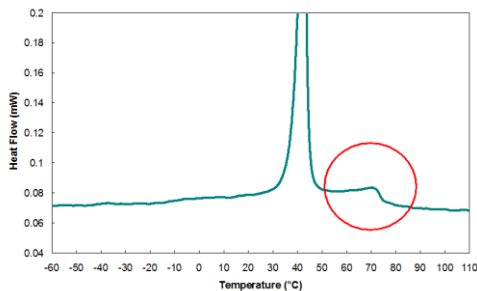
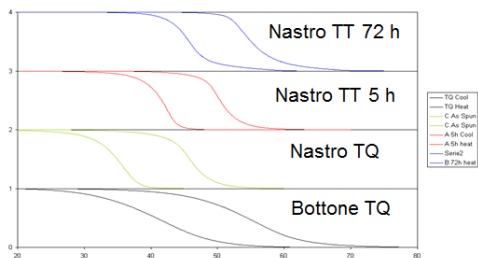
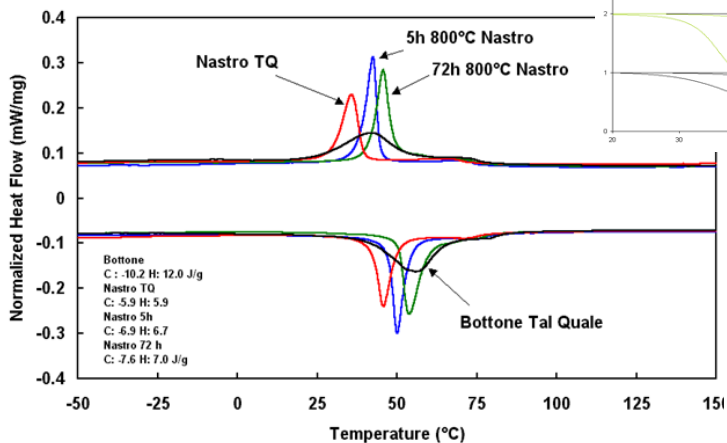


Instron E3000
[-150°C ↔ 350°C] 3KN
0.01-100Hz
Trazione, compressione,
torsione, flessione a due
punti, three point bending

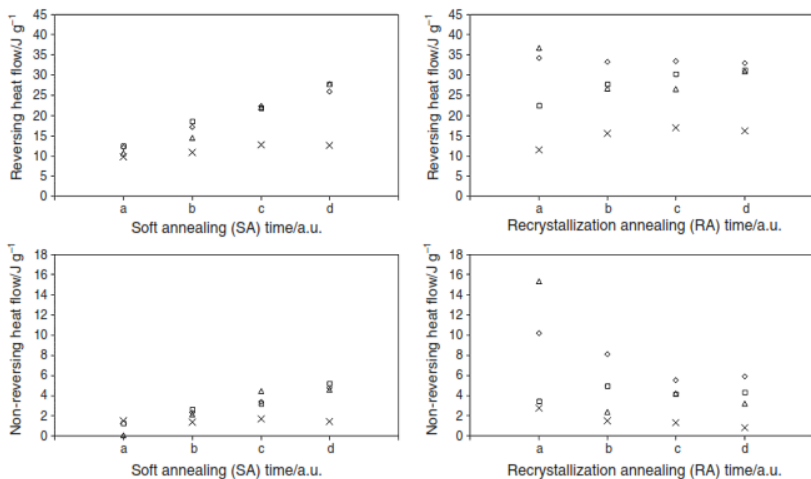
Analisi calorimetrica

Transizioni di fase: fusione, cristallizzazione, TMT, glass o Cp transition, Tc, Entalpia: ΔH , Entropia: ΔS , Calore specifico: MDSC in isoterma; Conducibilità termica per isolanti

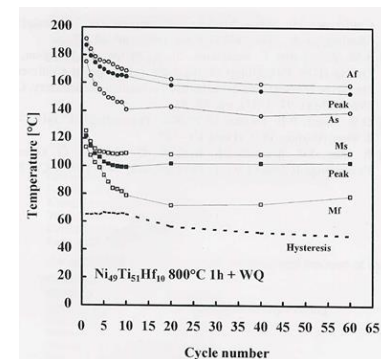
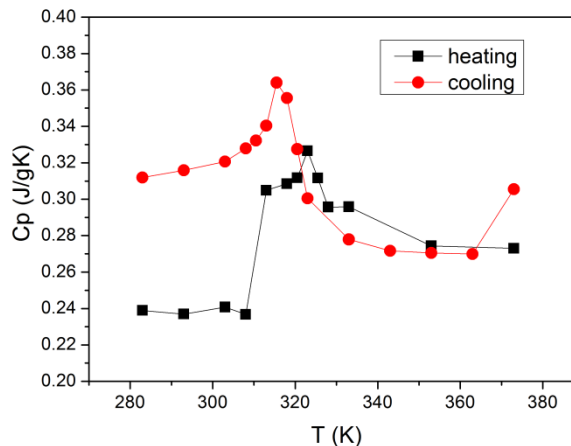
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$$\Delta S = \frac{\Delta H_{av}}{T_0} \quad T_0 = \frac{A_f + M_S}{2}$$



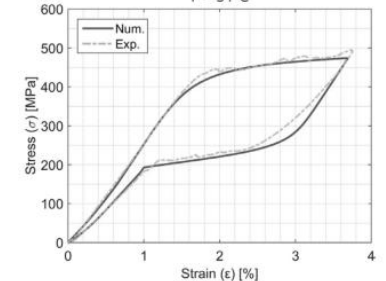
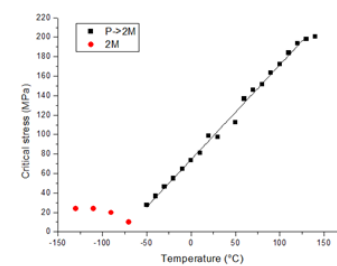
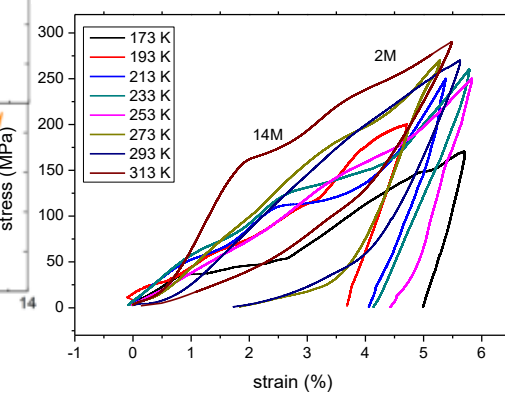
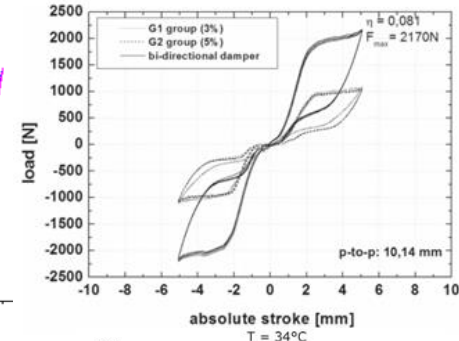
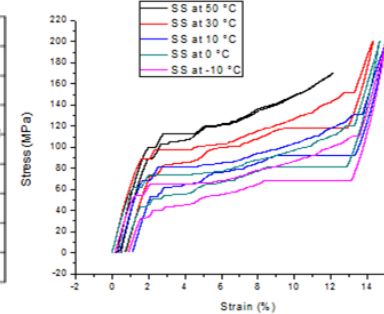
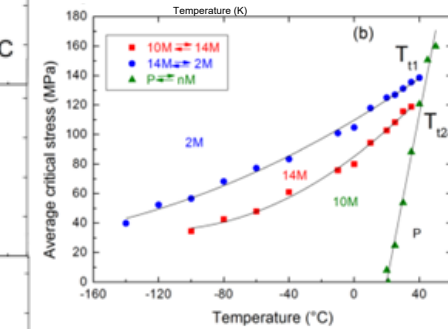
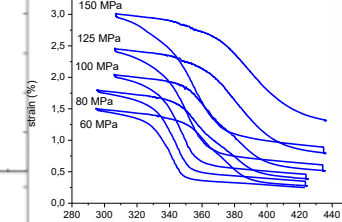
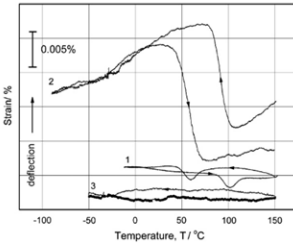
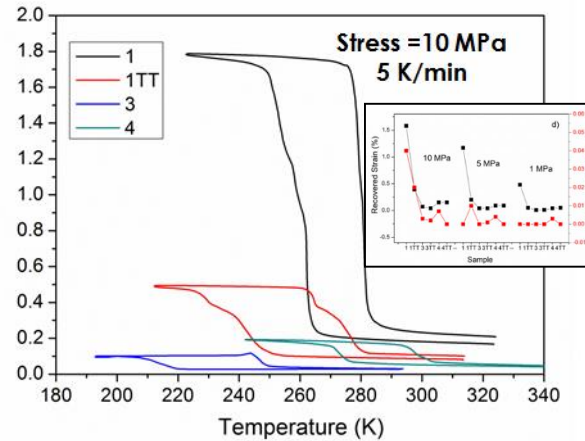
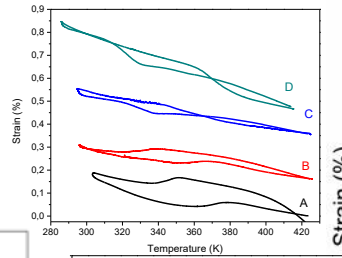
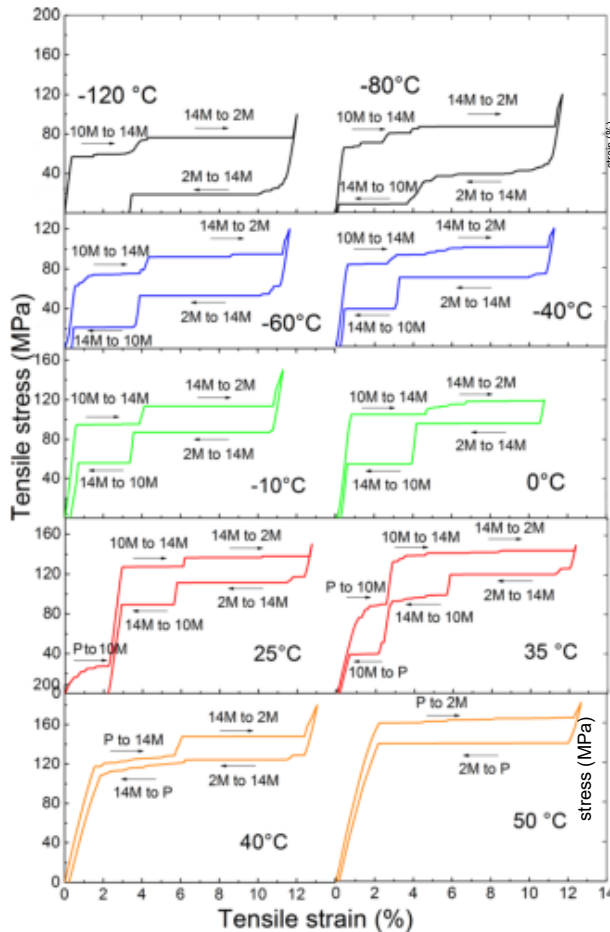
◇ NITI 0.305 □ NITI 0.247 △ NITI 0.152 × NITICu 0.305



ASTM E1952-06

Misure meccaniche statiche

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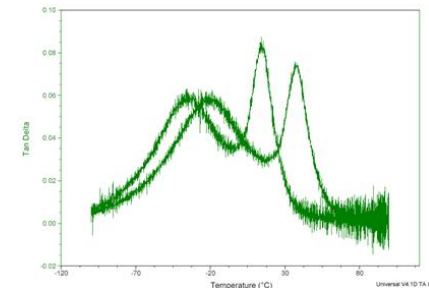
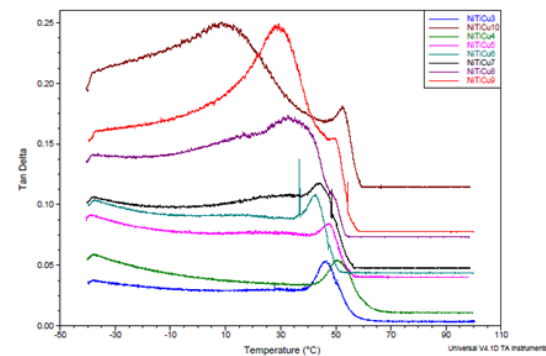
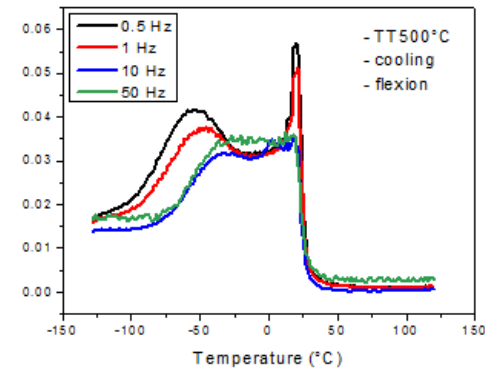
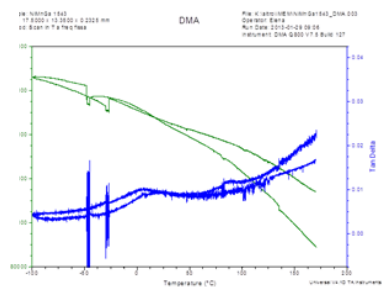
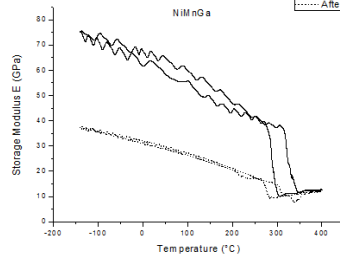
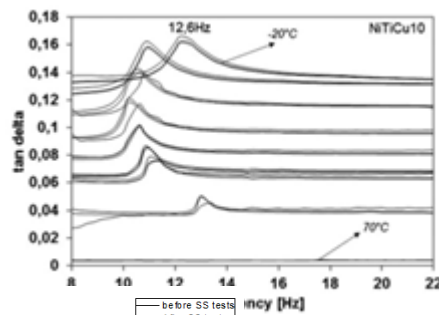
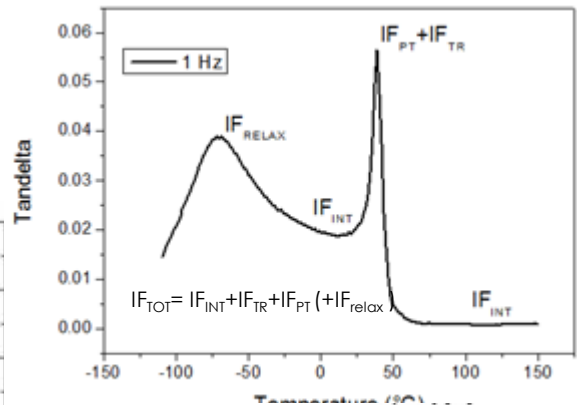
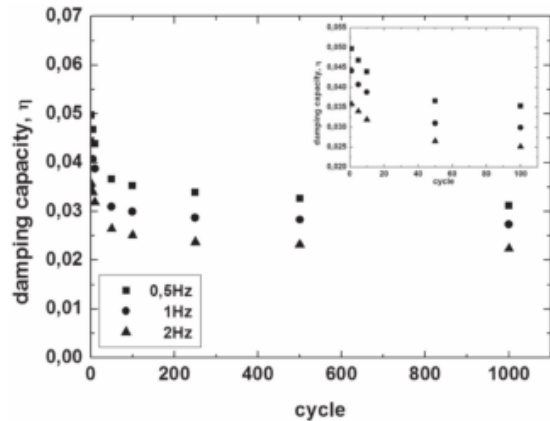
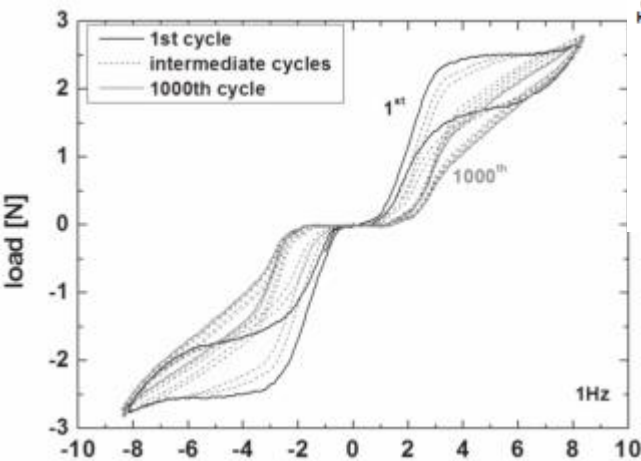
Modulo E, Carico rottura, Transizioni di fase:SS, SR
Studio numerico

Misure meccaniche dinamiche

$$IF = Q^{-1} = E''/E'$$

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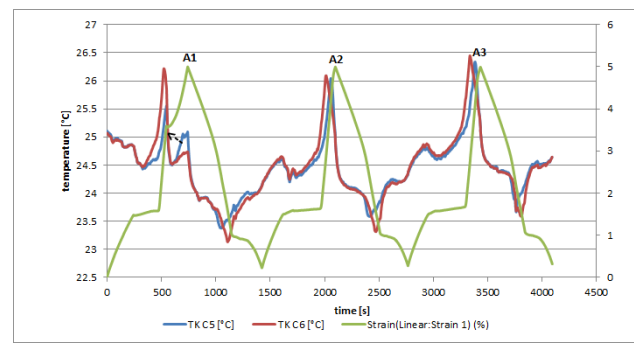
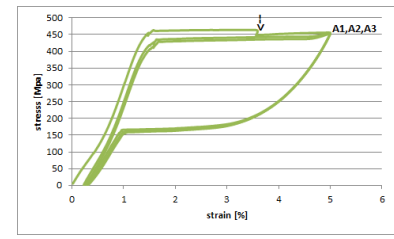
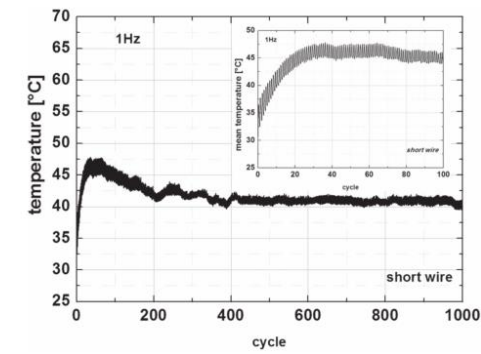
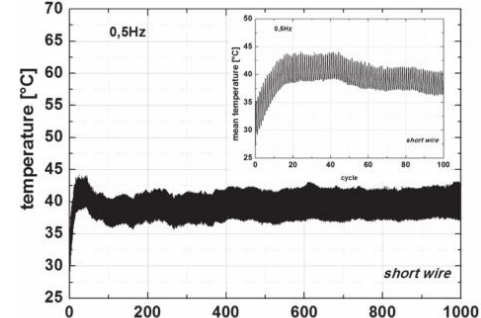
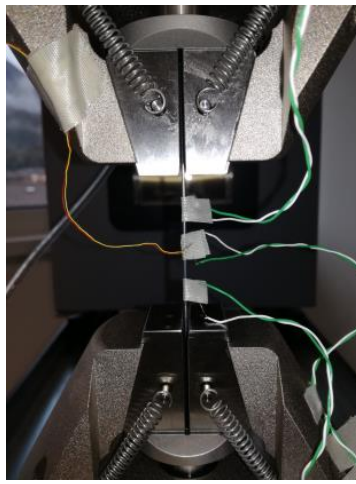
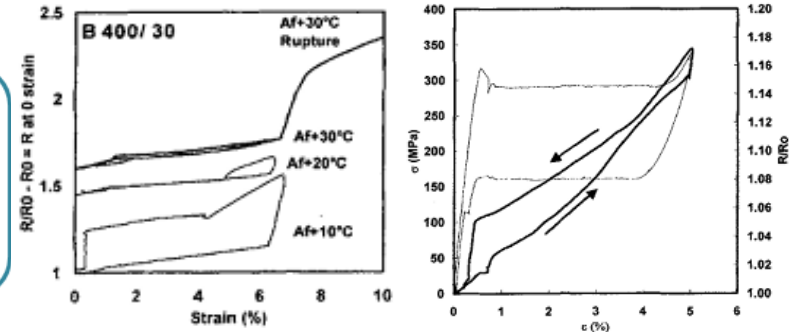
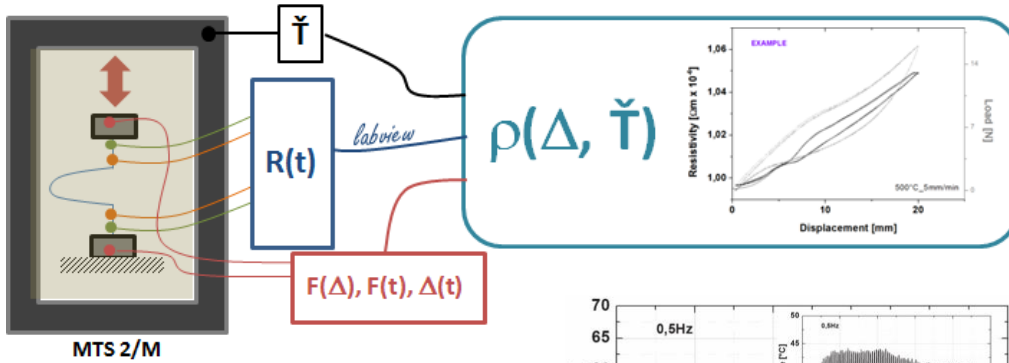
$$IF = W_d / 2\pi W_c$$



Set up ad hoc

Completamento con misure di resistenza elettrica o puntuali della T durante i test meccanici

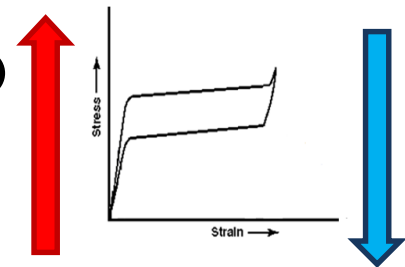
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Effetto Elastocalorico

Analisi termo-meccanica

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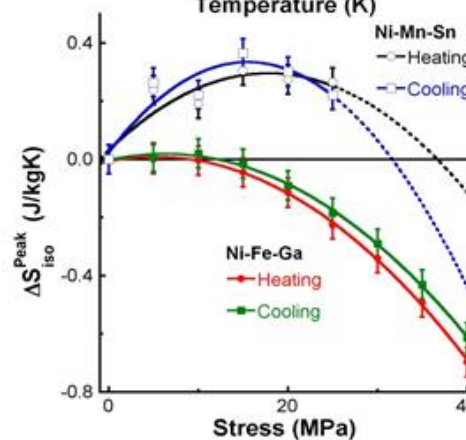
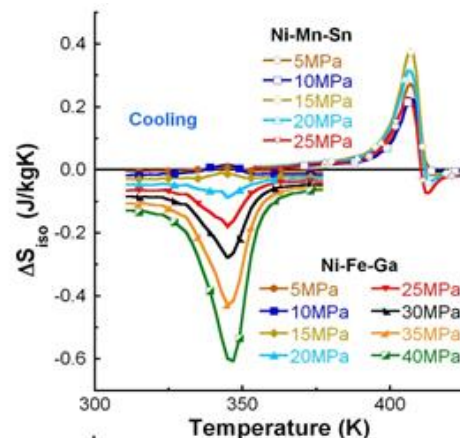
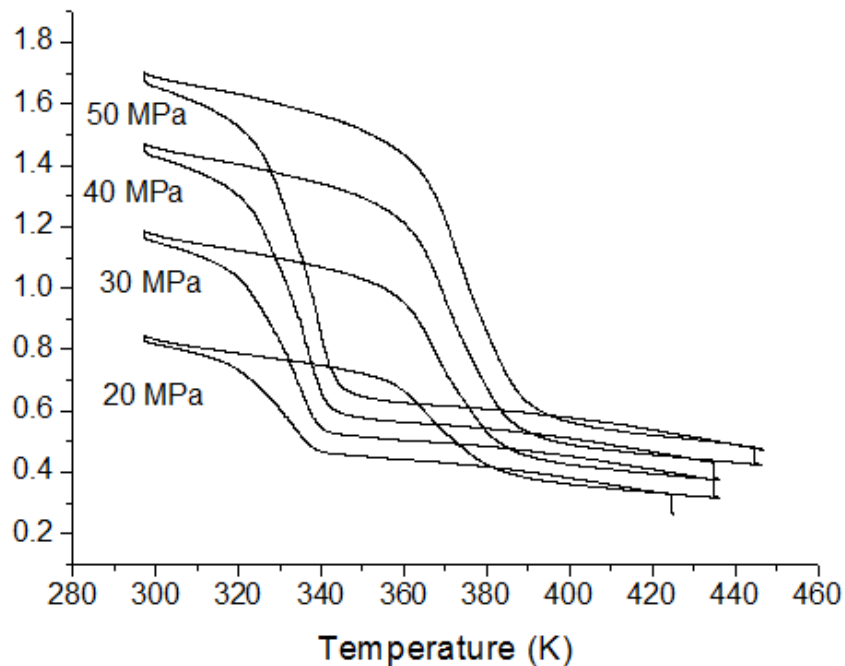
$$\Delta S_{iso}(T, \sigma) = \int_0^\sigma \frac{\partial \varepsilon(T, \sigma)}{\partial T} d\sigma$$

$$\Delta S_{iso} / \Delta T_{ad}$$

$$\Delta T_{ad} = \Delta H / C_p$$

DSC

$$COP = \Delta H / E_m$$



Grazie!