WWW.ASTRI.ORG.AU

Thermal stability of eutectic Na_2CO_3-NaCl and Na_2CO_3-Li_2CO_3 salts

Yifeng Jiang[1, 2], Yanping Sun[1*], Frank Bruno[3] and Sean Li[2]
[1]CSIRO Energy Flagship, PO Box 330, Newcastle, NSW 2300, Australia
[2]University of New South Wales, Sydney, NSW 2052, Australia
[3]University of South Australia, GPO Box 2471, Adelaide SA, 5000, Australia
*Corresponding email address: Yanping.Sun@csiro.au

ASTRI
AUSTRALIAN SOLAR THERMAL RESEARCH INITIATIVE

The development of the thermal energy storage of cost-effective high temperature phase change materials (PCMs) is one path to increase CSP value and reduce its cost [1]. However, the thermal stability of the PCMs at high temperature is a major concern.

Aim

- Investigate the thermal stability of eutectic Na_2CO_3-NaCl and Na_2CO_3-Li_2CO_3 salts for use as high temperature PCMs

Thermophysical properties of PCMs

Chloride and carbonate salts: high latent heat, cheap price, but their thermal stability is a critical factor for consideration for use as PCMs

Composition, wt.%	Tm(℃)	ΔHf (J/g)	Cost ($) per 100g	Reference	Sample ID
59.5%Na_2CO_3-40.5%NaCl	632.0	294.9	20.57	Factsage	PCM1
	637.0	283.0		This work	
Li_2CO_3(42)-58Na_2CO_3	498	393	58.29	Factsage	PCM2
	498.3	330.8		This work	

- The measured values of melting temperature and latent heat of PCM1 & PCM2 are consistent with those calculated using FactSage software 6.4

Effect of operating environments

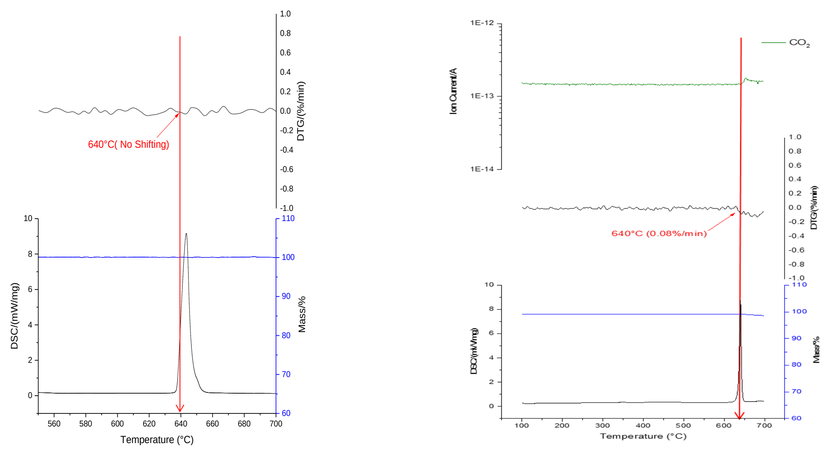

Fig. 1. DSC/TG-MS analysis of PCM1 in CO_2 (left) and N_2 (right)

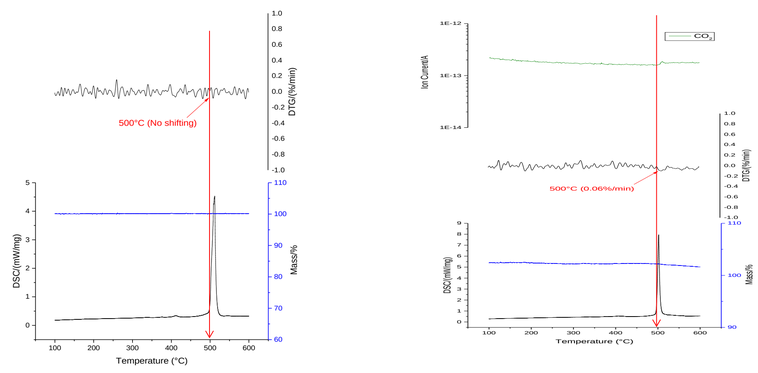

Fig. 2. DSC/TG-MS analysis of PCM2 in CO_2 (left) and N_2 (right)

- Thermal stability of PM1 and PM2 is affected by operating environments
- PCM1 and PCM2 show no weight loss around their melting points in CO_2 compared with PM1 with a 0.51 % weight loss and PM2 with 0.8% weight loss in N_2

Thermal cycling of PCMs in CO_2

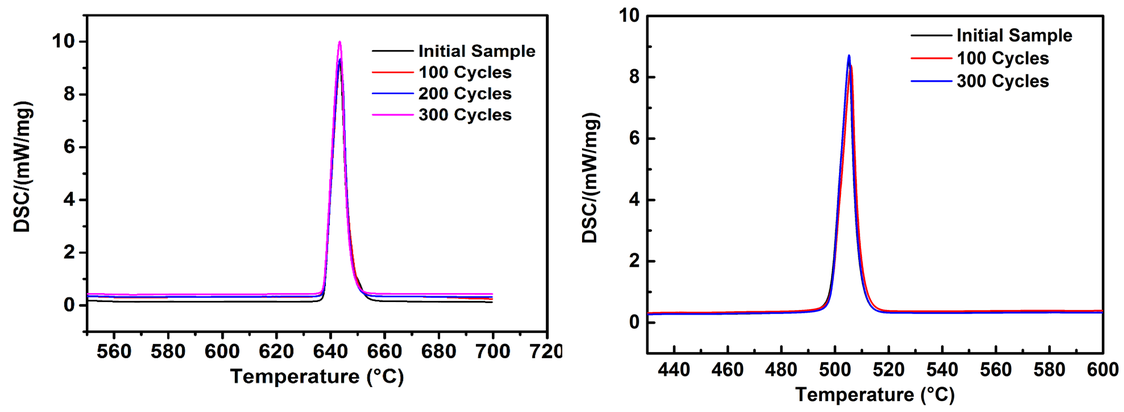

Fig. 3. DSC curves of initial samples and up to 300 cycled PM1 (left) and PM2 (right)

- Mono-peak DSC spectra of PM1 and PM2 were observed after 300 thermal cycling tests. suggesting that the eutectic salts are of uniform mixtures
- DSC curves of cycled salts do not shift much after 300 cycles as compared with the DSC curves of their initial salts

XRD analysis of PCMs

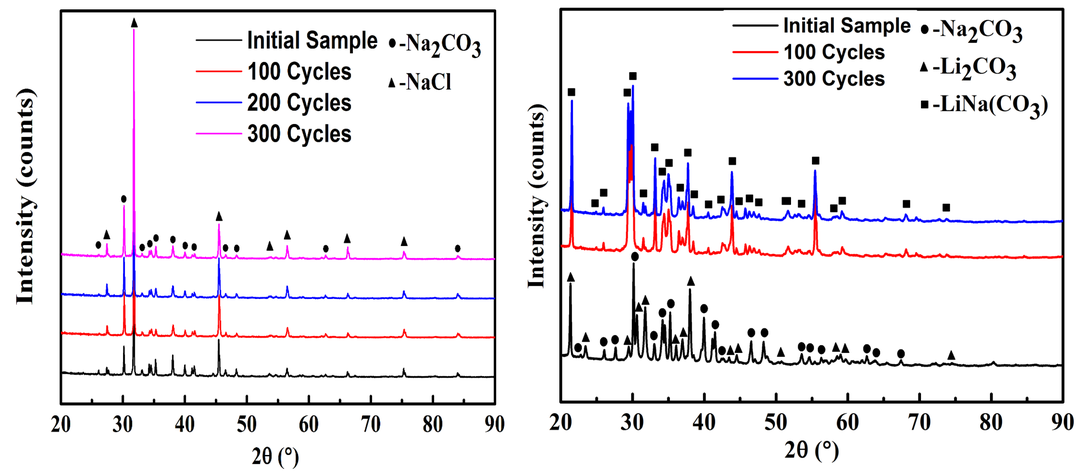

Fig.4. XRD patterns of initial sample and up to 300 cycled PM1 and PM2

- XRD patterns and intensities of cycled PM1 and PM2 were very similar to ones of their initial samples
- No obvious separated phase and composition changes occur after up to 300 thermal cycling tests

Conclusions

- PCM1 and PCM2 have good thermal stability without weight loss around their melting points in CO_2 compared with PM1 with a 0.51 % weight loss and PM2 with 0.8% weight loss in N_2
- PCM1 and PCM2 show the excellent thermal stability after 300 thermal cycling tests in CO_2
- PCM1 and PCM2 would be promising for use as high temperature PCMs in CO_2

AUTHOR CONTACT
e Yanping.Sun@csior.au
w www.astri.org.au

REFERENCES
1. K Nithyanandam, R. Pitchumani, Cost and performance analysis of concentrated solar power systems with integrated latent thermal energy storage, *Energy* 64 (**2014**) 793-810

ACKNOWLEDGEMENTS
This research was performed as part of the Australian Solar Thermal Research Initiative (ASTRI) project supported by the Australian Government, through the Australian Renewable Energy Agency (ARENA) as well as CSIRO Energy. Yifeng Jiang gratefully acknowledges the PhD Scholarship provided by CSIRO and UNSW