

Preliminary findings: Relationship between grain size, grain boundary orientation and strength for the SiC layer of TRISO coated particles.

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2nd Workshop on HTGR SiC Material Properties, Idaho Falls, 19 - 20 Jan 2012

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Agenda

- Introduction
- Experimental plan
- Preliminary results
- Conclusions
- Acknowledgements



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Introduction

- Typical research questions which still needs answers and understanding:
 - What is effect of very high temperature annealing on the microstructure and mechanical properties of SiC?
 - What is the effect of neutron irradiation on the microstructure and mechanical properties of SiC?
 - What is the predominant transport mechanism in SiC for fission products like Ag, Cs, I, etc?
 - What impact does grain properties (size, texture, grain boundary angles) have on the mechanical properties of SiC and how does it change as a result of neutron irradiation? Does it have any impact on Ag transport mechanism in SiC?
- Golden opportunity exists:
 - lessons learned from previous research work and available data & samples
 - examination of actual AGR-1 irradiated TRISO coated particles



Experimental Plan: Integration of "old" with "new"





Preliminary results

TRISO Coated Particles



TRISO CPs

Batch	SiC Deposition Temperature (°C)	SiC Deposition Rate (µm/min)	Weibull Modulus m	SiC Thickness (µm)	SiC Density (gcm ⁻³)	
G118 (ACF)	**1510	*	4.33	32	3.19	
G146 (ACF)	1450	0.23	2.61	39	3.2	
G169 (ACF)	1510	0.24	5.09	32	3.2	
B14 (RCF)	1585	0.17	2.15	30	3.19	
B10 (RCF)	1510	0.17	5.03	30	3.19	

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EBSD Examination matrix

Batch	Selected info for CVD reactors used for SiC production	Post-production annealing conditions											
		Reference	1000°C	1300°C	1500°C	1600°C	1700°C	1600°C	1800°C	1900°C	1980°C	2000°C	2100°C
		annealing)	1h	1h	1h	1h	1h	100h	1h	1h	1h	30min	10min
G118	ACF 1510°C	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU	NMMU
G146	ACF 1450°C	ISU				ISU		ISU	ISU			ISU	
G169	ACF 1510°C	ISU			1813	ISU		ISU	ISU			ISU	
B14	RCF 1585°C	NMMU	NMMU			ISU		ISU	ISU			ISU	ISU
B10	RCF 1510°C	NMMU	NMMU			ISU		ISU	ISU			ISU	ISU

Samples for ISU studies arrived 14 January 2012 EBSD at NMMU will start week of 23 January 2012 Next Generation Nuclear Plant

Preliminary results



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Preliminary results: Compression strength



1 hour annealing at 1600°C (\bar{a} = average strength, σ_0 = characteristic strength and m = Weibull modulus)

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Preliminary results: Characteristic strength-Temp





Preliminary results: SiC-IPyC Interlayer - Strength





TREND SUGGESTED Needs to standardize interlayer measurement Standard deviation (Error bar)

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Preliminary Results: Nano Indentation





Preliminary results

TRISO Coated Particles

- No actual EBSD measurements on <u>irradiated</u> AGR-1 TRISO coated particles were completed yet but is planned.
 - Sample preparation studies were undertaken in controlled environments to do EBSD measurements on metallographic prepared samples (to eliminate time on overloaded FIB)
 - Limited time available on electron microscopes (focus firstly on microstructure and fission product precipitates)



Conclusions

• This project will provide valuable comparative results in the next 12 months where the integration of the results will be adding value

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Acknowledgements

- PBMR for initial funding for TRISO coated particles & annealing
- Johannes Mahlangu (annealing) & Motshudi Mokoduwe (ASTM grain size)
- Jaco Olivier, Justin Downey & William Goosen for nano hardness measurement & initial EBSD

