WARM TEMPERATURE (170-280°C) UNIAXIAL COMPRESION OF SiC REINFORCED MMCs

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Outline

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  - Justification for the research
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- Experimental Procedure
  - Materials
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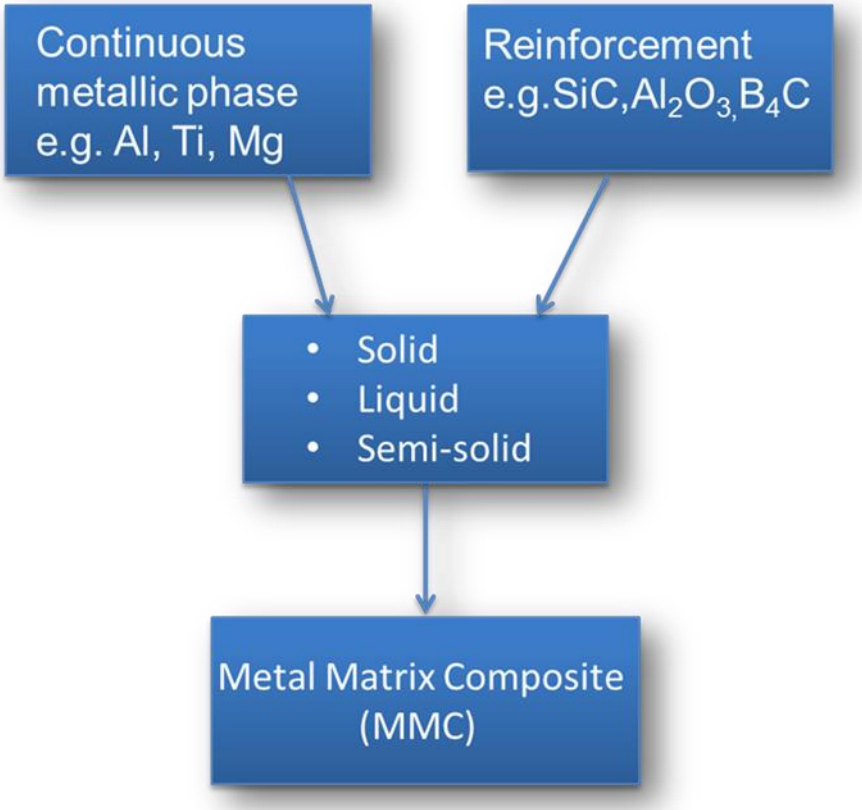
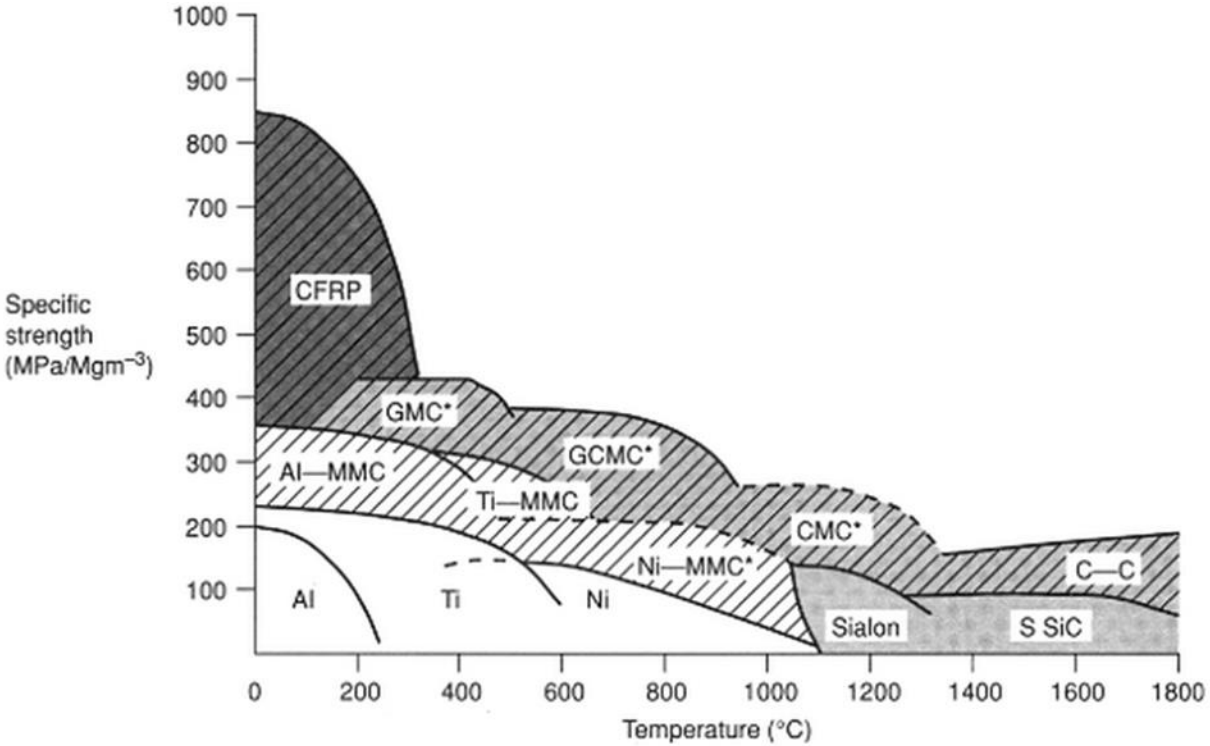
- Acknowledgements

Introduction: Background



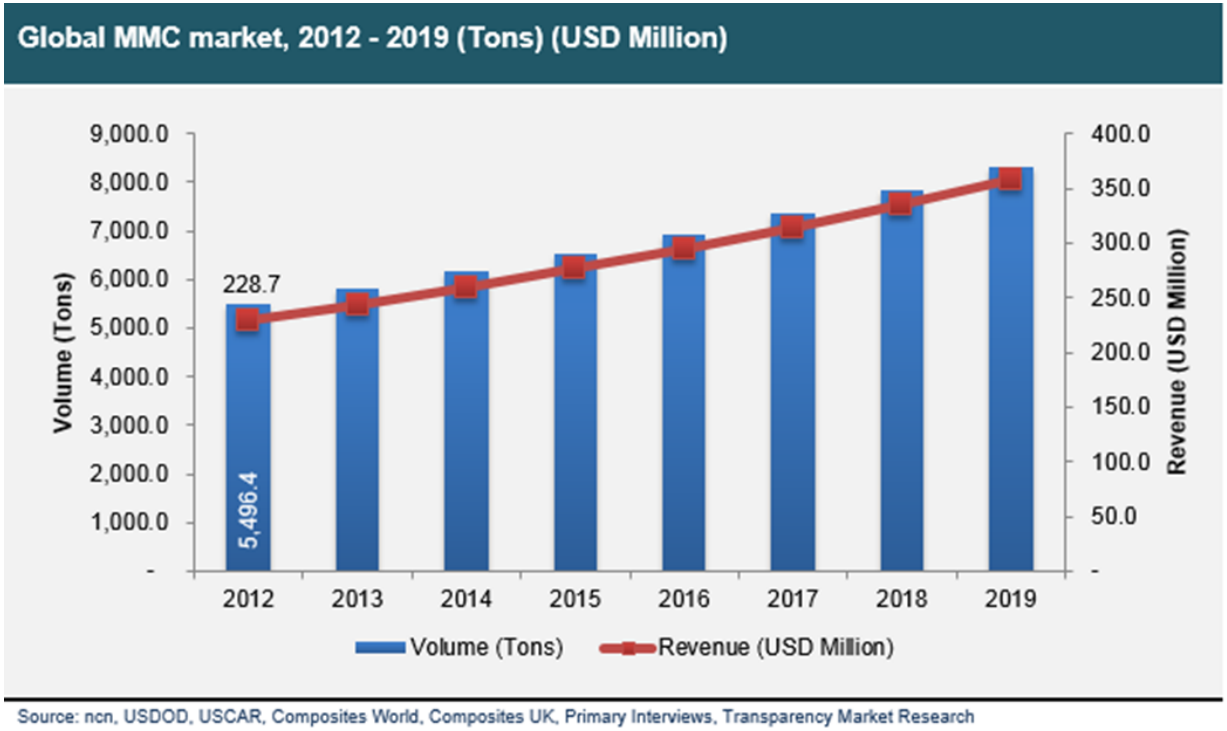
Introduction: Background

Strength of Al MMCs > strength of unreinforced Al



Introduction: Background

There is a growing demand for <u>lightweight</u> and <u>high performance</u> = ↑ interest in MMCs and MMNCs

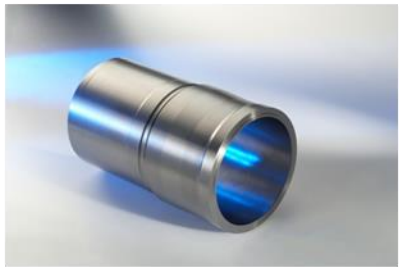


Introduction: Background

Application : aerospace, automotive and sporting goods

Brake discs: MMC-A359/SiC/20p

Driveshafts



Piston liners

Bicycle components

Golf clubs

- No MMC producer in SA so we must demonstrate capability to produce them!!!

Introduction: Justification for the research

- Mechanical properties of MMCs and MMNCs mainly influenced by:
  - distribution of reinforcement phase in matrix material
  - strength of interfacial bonds

- Ideal composite = reinforcement phase uniformly distributed in matrix material

Introduction: Justification for the research

- Deformation processes such as extrusion, rolling, forging or drawing may improve distribution of reinforcement in matrix and strengthen interfacial bonds.

- These deformation processes often carried out at high temperatures due to increased plastic flow so more deformation is achieved.

- Disadvantages of operating at ↑ temps include:
  - high energy costs
  - reduced equipment and tool life
  - poor surface finish

Introduction:
Justification for the research

- Uniaxial compression tests at warm working temperatures on Gleeble 3500.
- Errors made and costs incurred in laboratory and experimental plant trials minimised.

Objective

To use a Gleeble 3500 thermomechanical simulator to study the warm temperature uniaxial compression of SiC reinforced MMCs.

Experimental procedure

- **Materials:**
  - 2124 aluminium alloy powder
  - micron-sized (3-7µm) SiC powder

- MMCs: 10 or 15 vol.% SiC in the matrix

Experimental procedure

- Three main steps:

Blending using a high energy ball mill. The blending media was 5mm steel balls in a 2L steel jar.

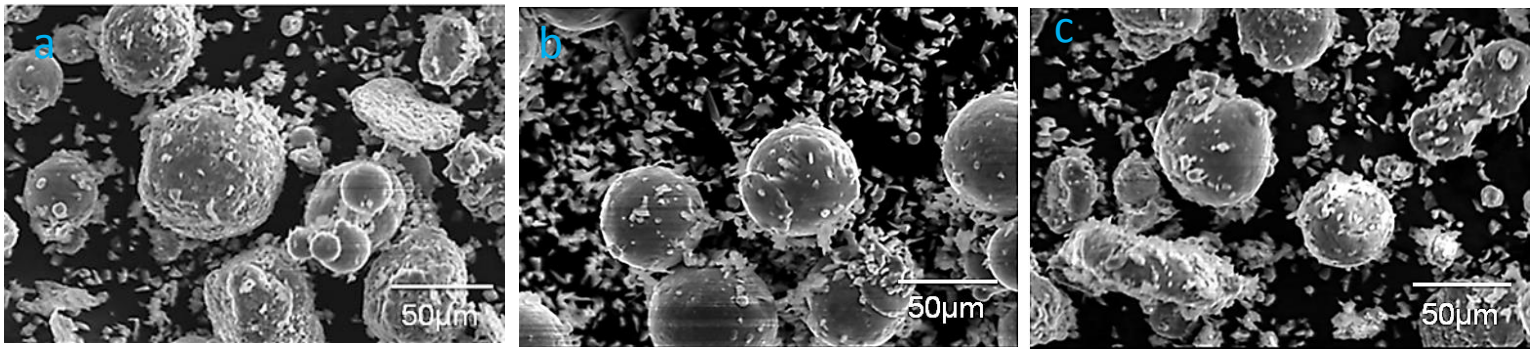
Cold (ambient temperature) Compaction with the aid of an Enerpac VLP 100 ton cold press.

Uniaxial compression at ambient temp.,170,220 and 280°C on Gleeble 3500

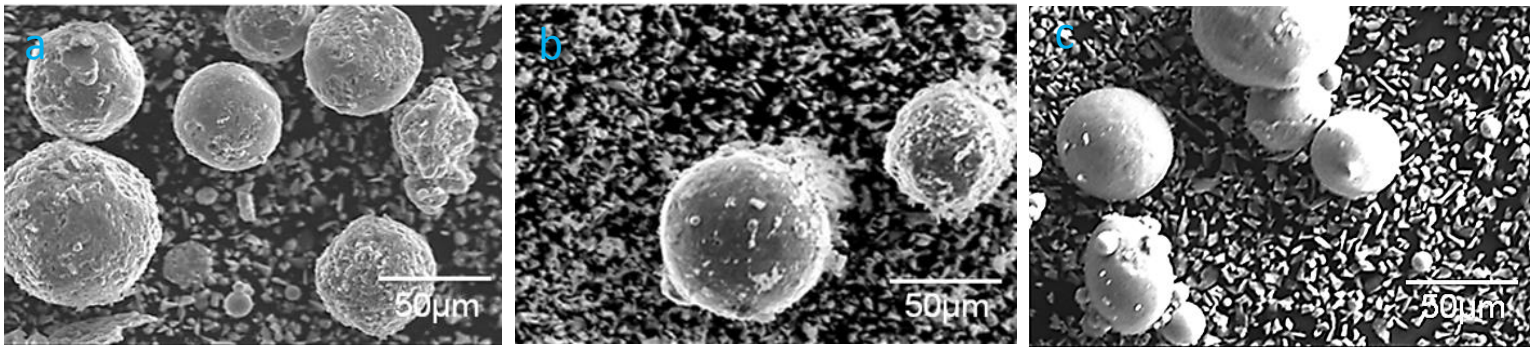
Results and Discussion: Ball milled powder

SiC in 2124-Al powder

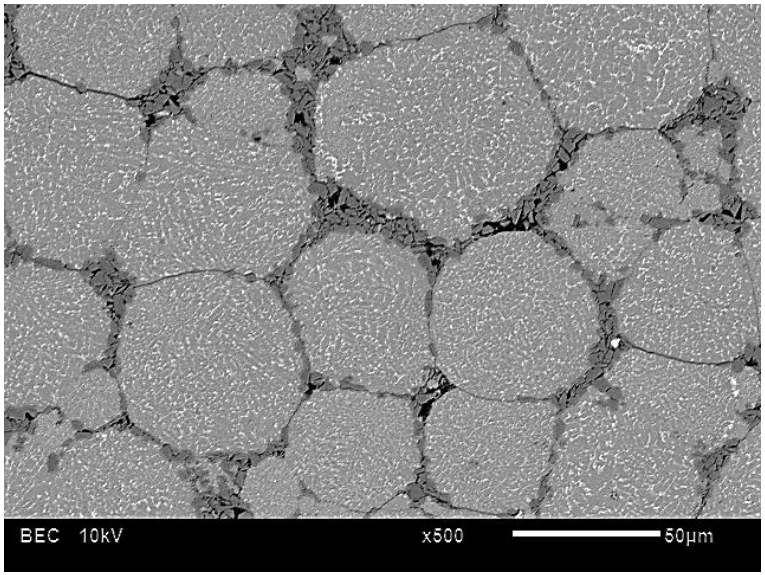
- 10% SiC



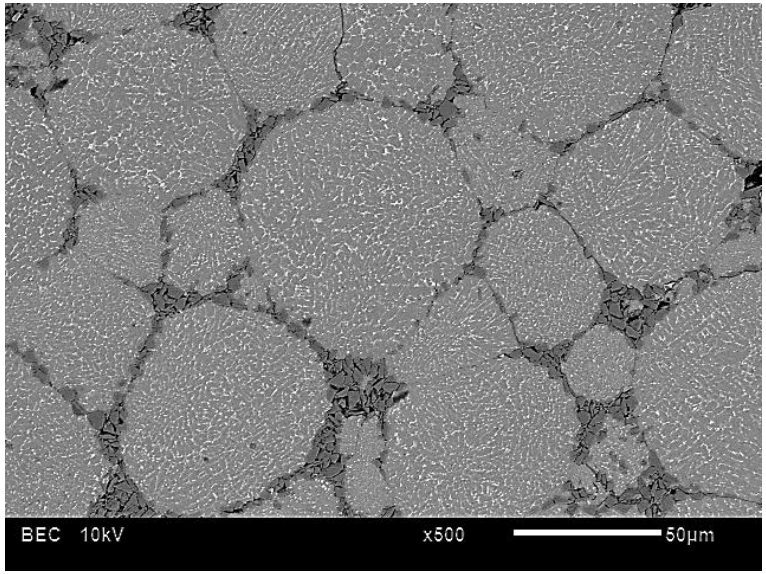
- 15% SiC



Results and Discussion: Compaction

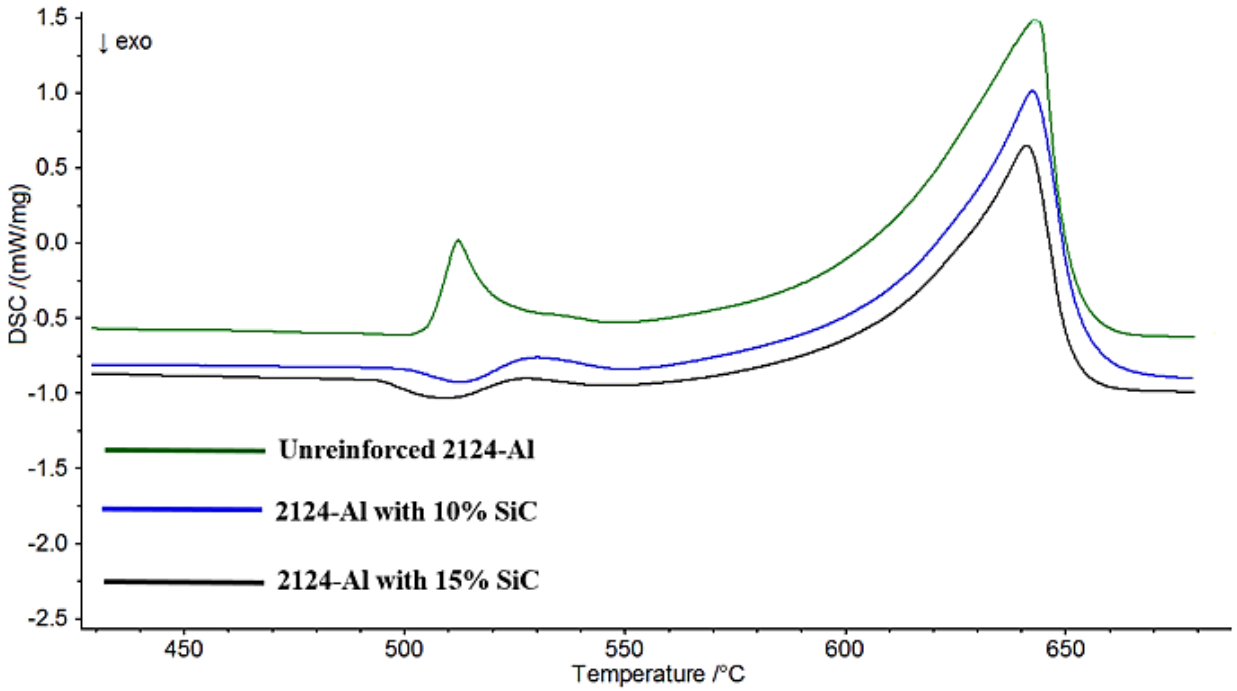


Surface

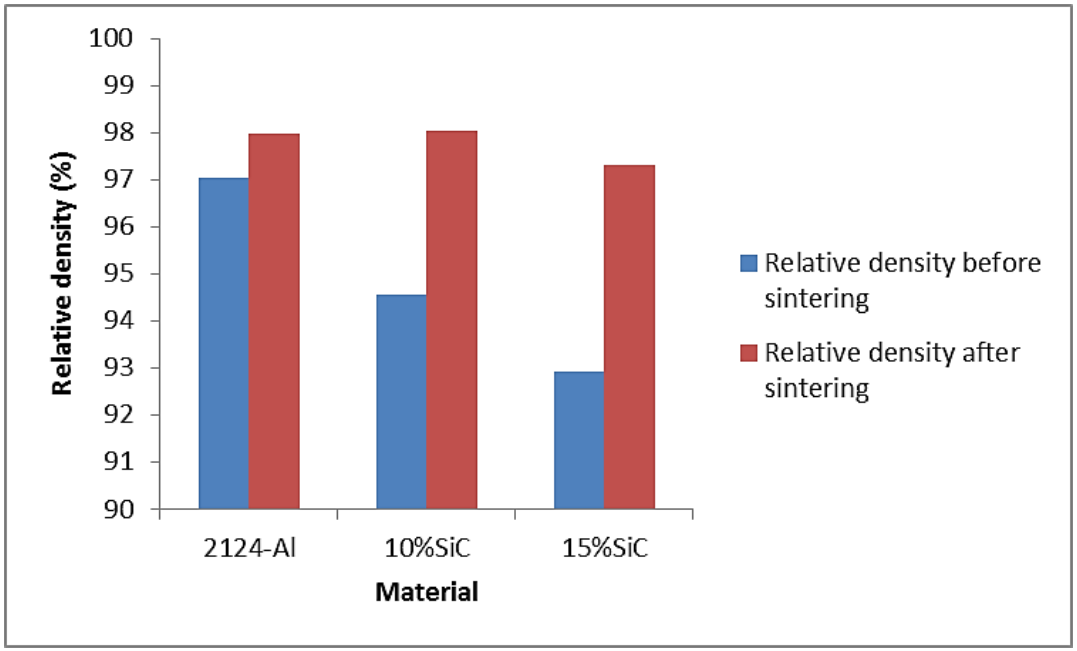


Core

Results and Discussion: DSC study

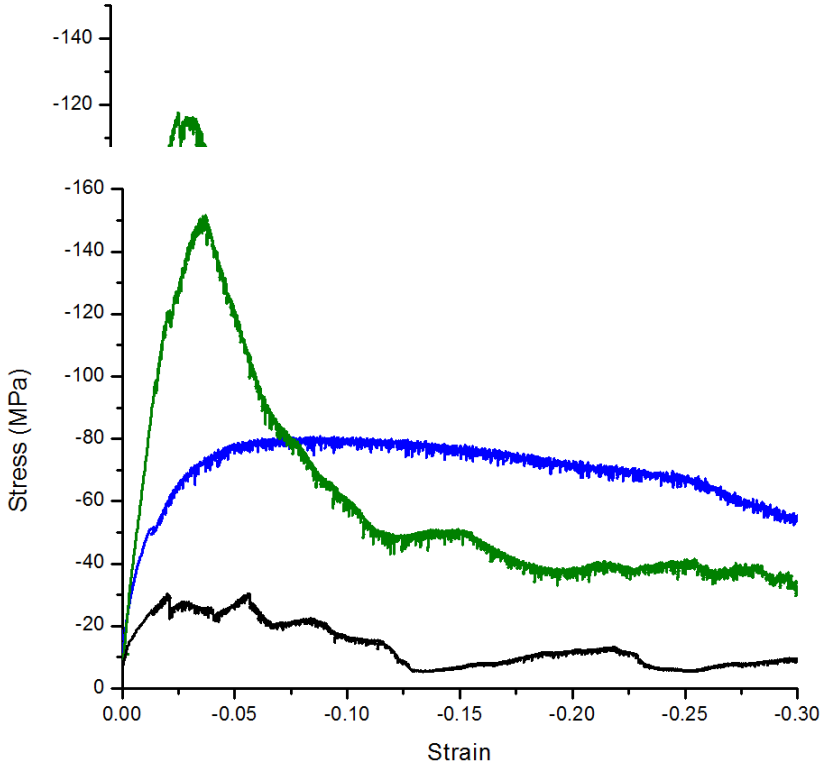


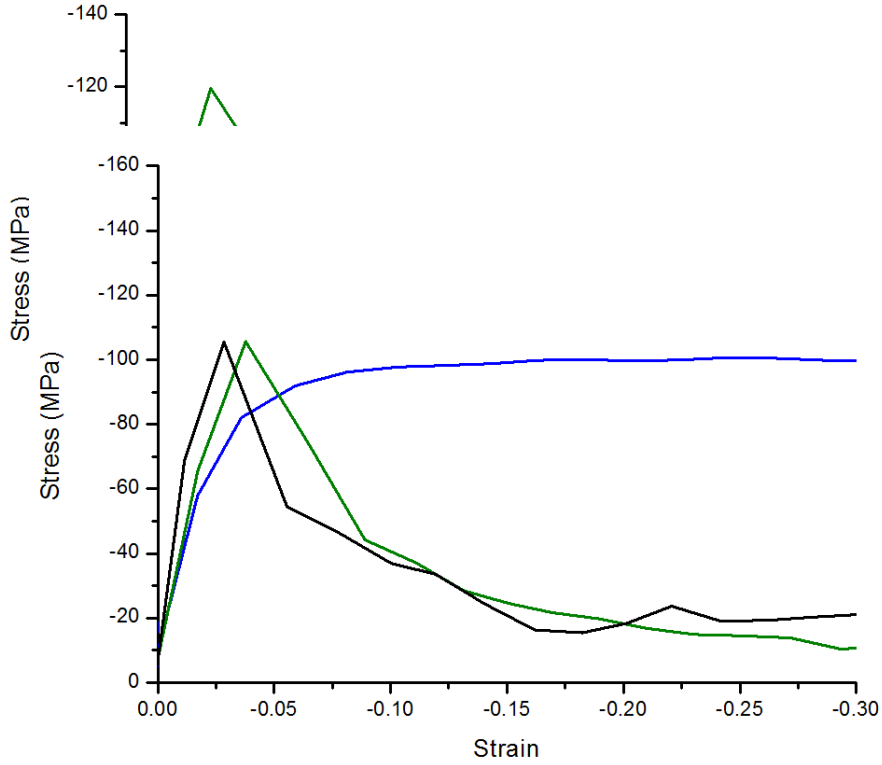
Results and Discussion: Sintering



Results and Discussion: Uniaxial compression tests

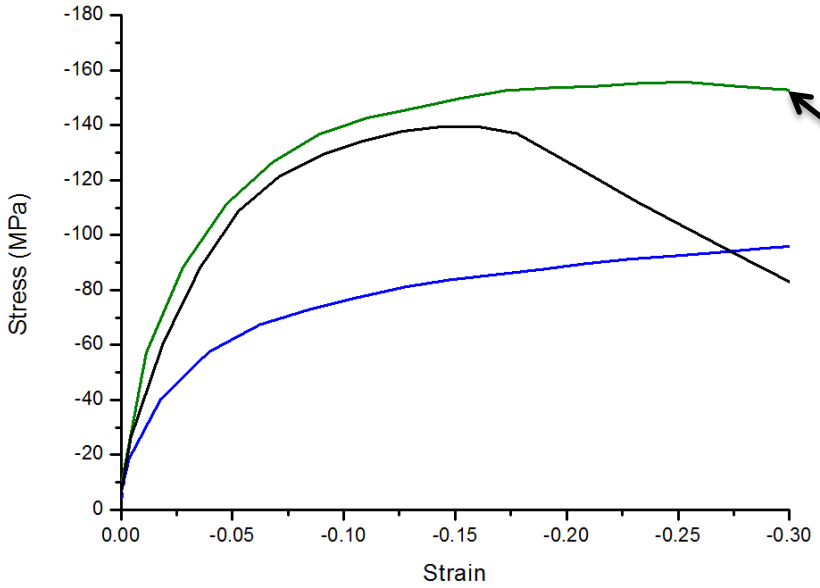
170°C





Results and Discussion: Uniaxial compression tests

280°C



Conclusions

1. **Uniaxial compression testing showed that it is possible to deform SiC reinforced MMCs at warm working temperatures.**

2. **The best deformation was achieved in the 2124-Al with 10%SiC MMC. When the 2124-Al with 10%SiC sintered MMC was uniaxially compressed at 280°C using a soaking time of 20 min., it deformed at a higher stress of 153 Mpa up to the maximum strain of 0.3**

3. **The addition of SiC reinforcing particles decreased the compressibility of the 2124-Al alloy since the MMCs had lower relative densities than unreinforced 2124-Al after compaction (*i.e.* before sintering)**

4. **Sintering increased the relative densities of all the materials and the 2124-Al with 10%SiC MMC had the highest relative density (98.05%) after sintering.**

Acknowledgements

- The CSIR
- The University of the Witwatersrand & DST-NRF CoE in strong materials
- Mr Sigqibo Camagu
- Dr. U Curle
- Miss Linda Mahlatji
- Mr Martin William
- Mr Ndumiso Mnguni
- Mr Michael Bodunrin
- Mr Ndivhuwo Nelwalani

Thank you