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Materials Information Pack

neo NORSK ELEKTRO OPTIKK AS
SINTEF
LSA Laser Analytical Systems & Automation
Fraunhofer
RHI MAGNESITA
Crowdhelix COLLABORATION INTELLIGENCE
cpi
INNOLAS LASER
MONTAN UNIVERSITÄT LEOBEN

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mRefCem and mRefFerro

- mRefCem and mRefFerro are fine powder materials produced by the milling of spent refractory linings from the cement and steel industries.
- Both materials present the option of improved sustainability of materials. The carbon footprint of products can be reduced by utilisation of a product originating from a secondary source.
- Both materials can be functionalised with silanes, designed for specific applications.

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mRefCem

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Technical Data Sheet mRefCem

Form	Fine powder
Colour	Cream (L: 84.70; a: 0.85; b: 10.73)
Average particle size, D_{50} / µm	6
Particles > 20 µm size / %	0.12
Bulk density / gcm^{-3}	0.6
Skeletal density / gcm^{-3}	2.9
Residual moisture content / %	0.35
Specific surface area (BET, N_2, 77K) / m^2g^{-1}	9
Mineral composition	Main mineral: Periclase, MgO (55 - 65 %) Secondary minerals: Brucite, $Mg(OH)_2$ (20 – 25 %) Calcite, $CaCO_3$ (5 – 10 %) Spinel, $MgAl_2O_4$ (5 – 10 %)
TGA Loss (1000 °C) / %	< 15

Colour: #DED2BE

Mineral	Hardness (Mohs)
Periclase	6
Brucite	2.5 - 3
Calcite	3
Spinel	8

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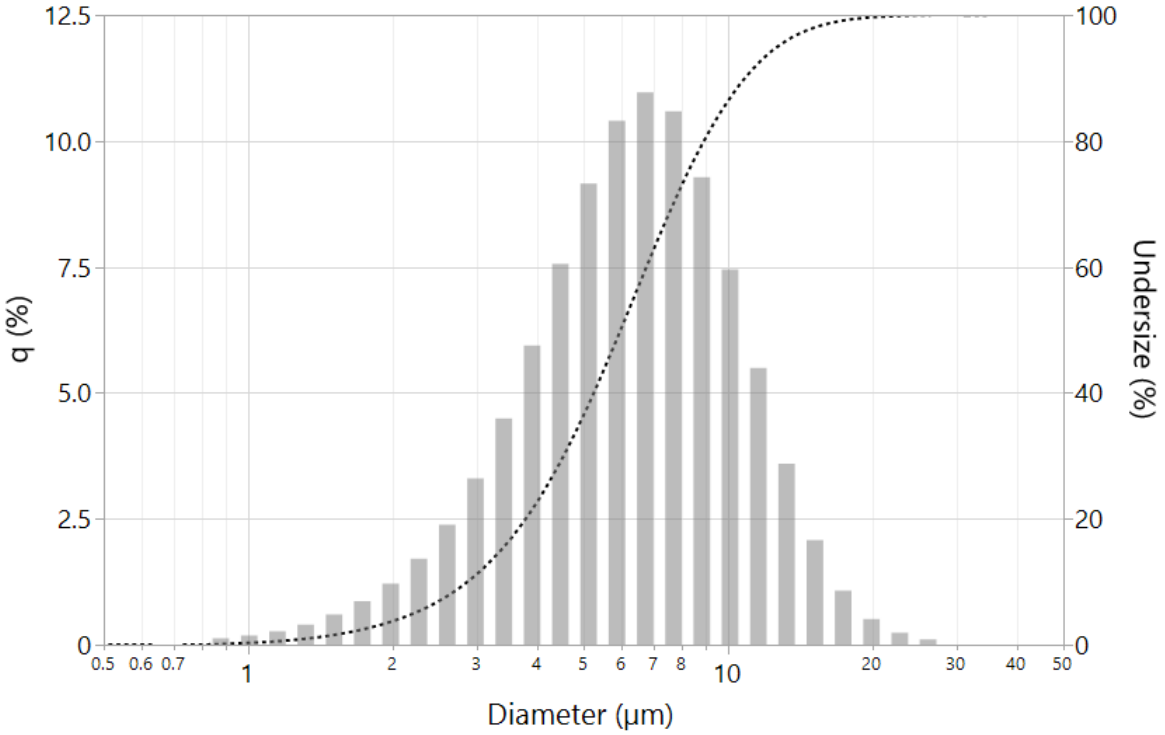
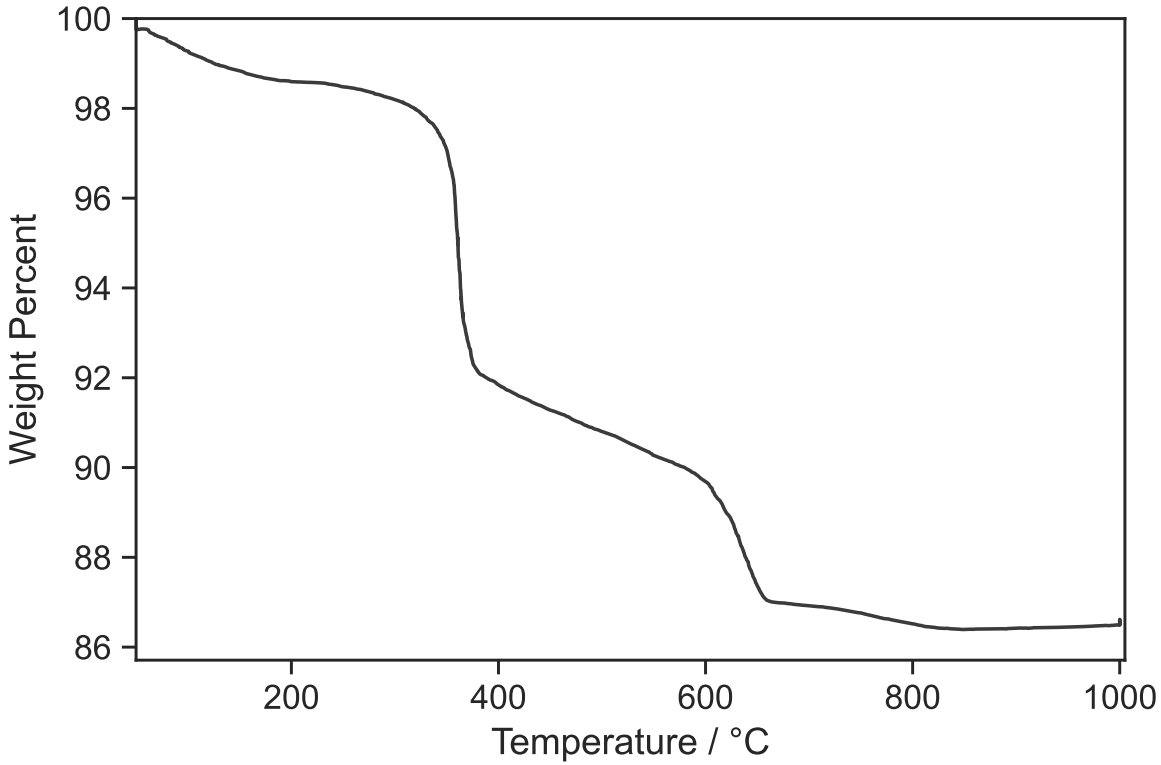
Technical Data Sheet mRefCem

PSD:



TGA (air):



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Properties of the initial material (0 – 5 mm) RefCem

	Thermal Conductivity	Electrical Resistivity	Dielectric Properties	Magnetic Properties
	Graphene 5300 W/mK	Quartz powder 7.5×10^{17} Ωm	Barium titanate nanoparticles ε_r : 220 (at 1 MHz)	Iron Max μ_r : 5000
RefCem	**Insulator:** 0.2 – 0.6 W/mK	**Insulator**: 870 Ωm	**Dielectric**: (at 1 MHz) ε_r' : 102 ε_r'' : 112	**Paramagnetic**: (at 1 MHz) μ_r' : 1.15 μ_r'' : 0.23
	Silica powder 0.013 – 0.04 W/mK	Copper 1.68×10^{-8} Ωm	Boron Nitride ε_r : 1.78 (at 1 MHz)	Copper μ_r : 0.999994

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Potential Applications mRefCem

- From the composition and measured properties, we anticipate the material to have potential for applications including:

- Dielectric materials *
- Fire retardant materials *
- Thermally insulating materials
- Extender replacement for bulk moulding compounds *

* Ongoing investigations

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mRefFerro

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Technical Data Sheet mRefFerro

Form	Fine powder
Colour	Dark grey (L: 47.73; a: -1.10; b: 1.03)
Average particle size, D_{50} / µm	7
Particles > 20 µm size / %	2.23
Bulk density / gcm^{-3}	0.5
Skeletal density / gcm^{-3}	2.7
Residual moisture content / %	0.97
Specific surface area (BET, N_2, 77K) / m^2g^{-1}	30
Mineral composition	Main mineral: Periclase, MgO (35 – 40 %) Secondary minerals: Graphite (30 – 35 %) Brucite, $Mg(OH)_2$ (15 – 20 %) Corundum, Al_2O_3 (0 – 10 %) Calcite, $CaCO_3$ (2 – 5 %) Spinel, $MgAl_2O_4$ (0 – 5 %)
TGA Loss (1000 °C) / %	< 26

Colour: #70726F

Mineral	Hardness (Mohs)
Periclase	6
Graphite	1-2
Brucite	2.5 – 3
Corundum	9
Calcite	3
Spinel	8

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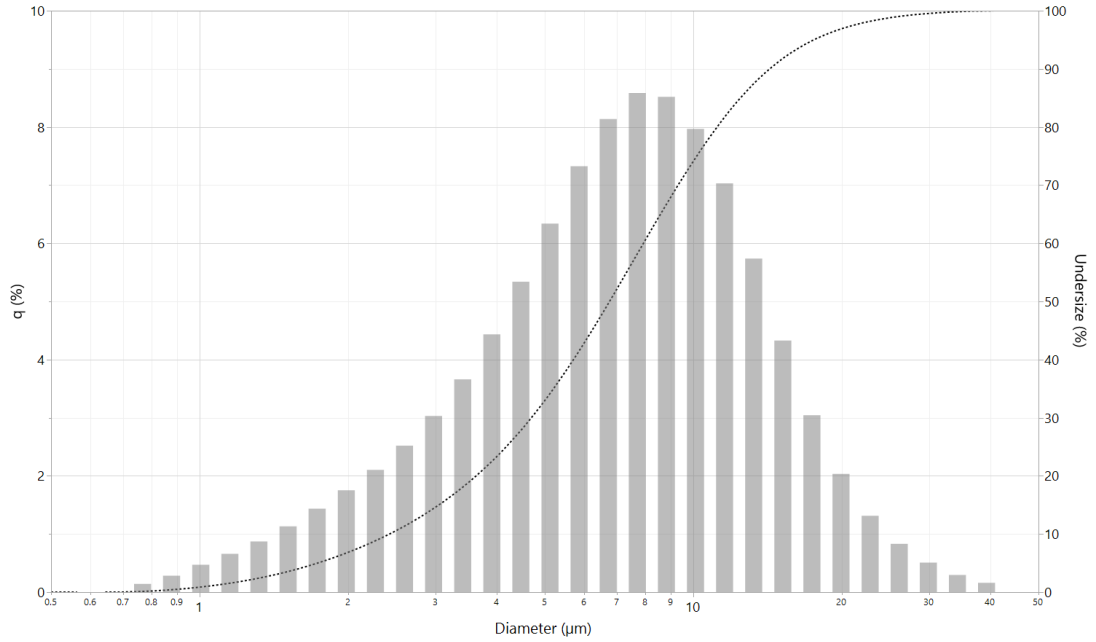
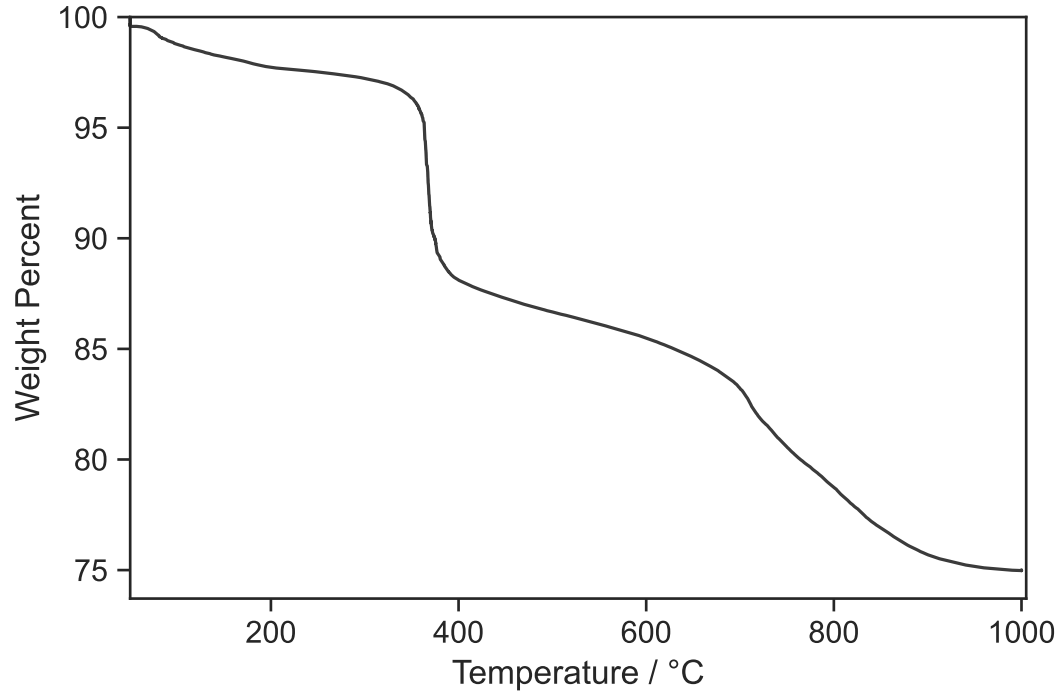
Technical Data Sheet mRefFerro

PSD:



TGA (air):



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Properties of the initial material (0 – 5 mm) RefFerro

	Thermal Conductivity	Electrical Resistivity	Dielectric Properties	Magnetic Properties
	Graphene 5300 W/mK	Quartz powder 7.5×10^{17} Ωm	Barium titanate nanoparticles ε_r : 220 (at 1 MHz)	Iron Max μ_r : 5000
RefFerro	**Insulator:** 0.2 – 0.5 W/mK	**Conductor**: 0.02 Ωm	**Inductor**: (at 1 MHz) ε_r' : - 2.2×10^5 ε_r'' : 1.7×10^6	**Paramagnetic**: (at 1 MHz) μ_r' : 1.1 μ_r'' : 0.19
	Silica powder 0.013 – 0.04 W/mK	Copper 1.68×10^{-8} Ωm	Boron Nitride ε_r : 1.78 (at 1 MHz)	Copper μ_r : 0.999994

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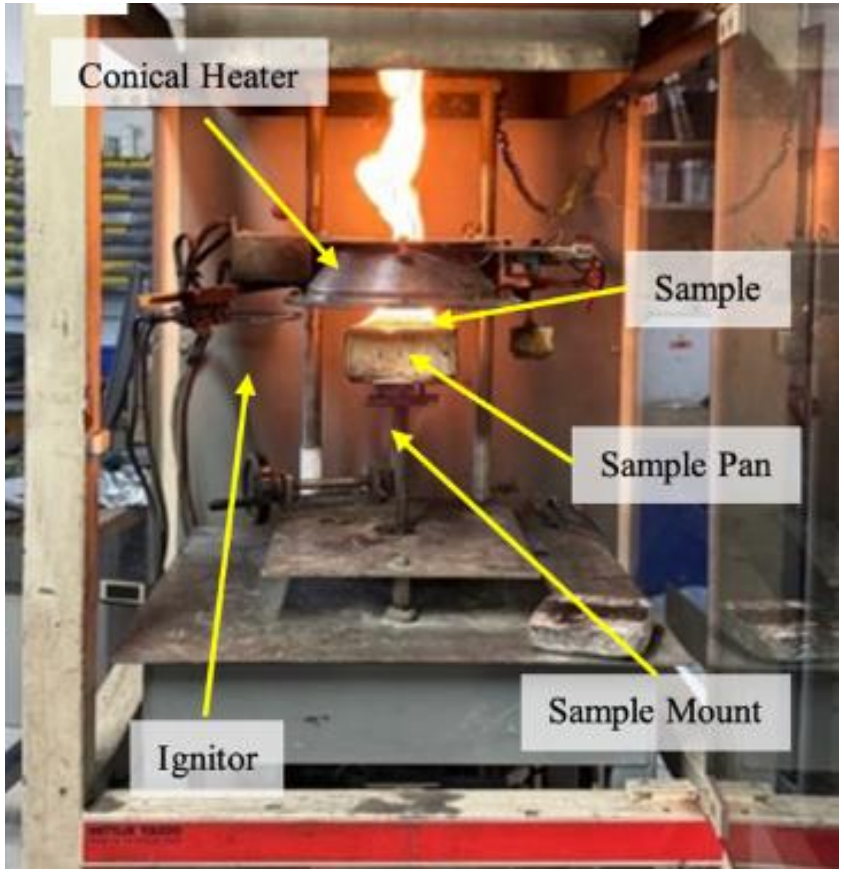
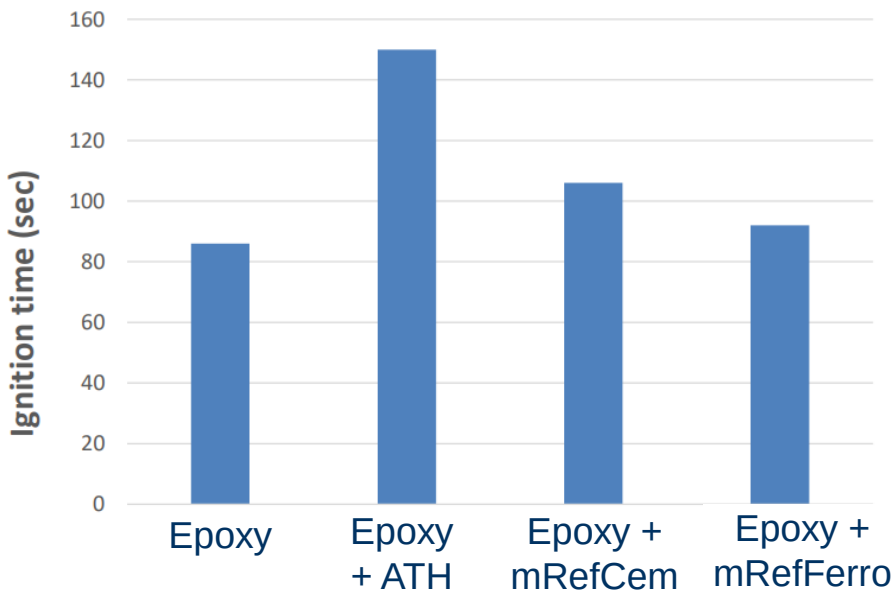
Burning test



The University of Edinburgh



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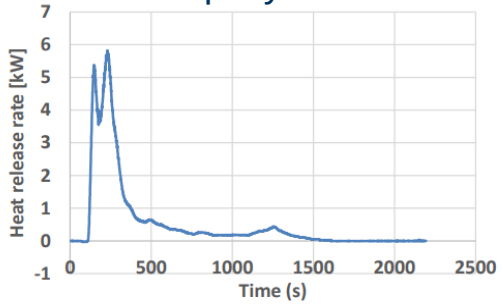
Burning test

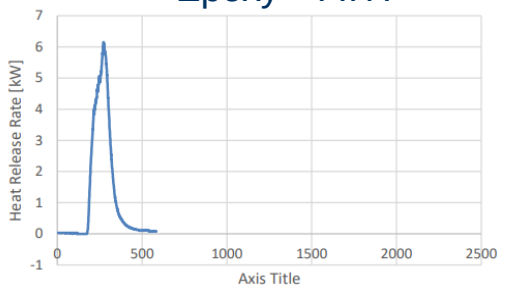
The University of Edinburgh

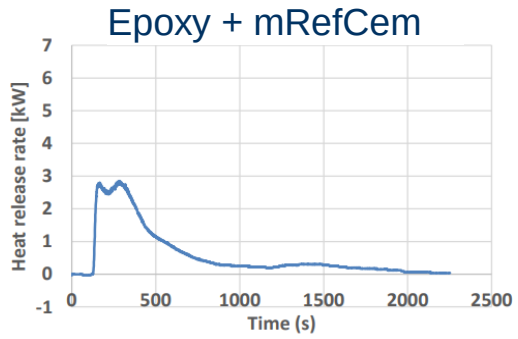
Institute for Materials & Processes

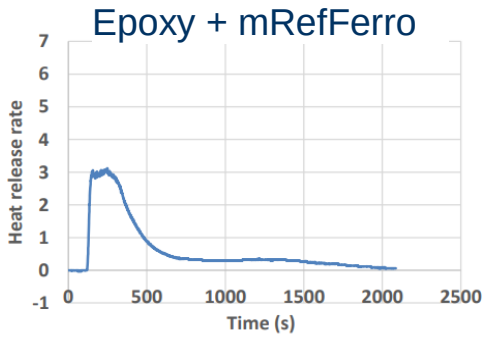
Heat Release Rate

3









The University of Edinburgh

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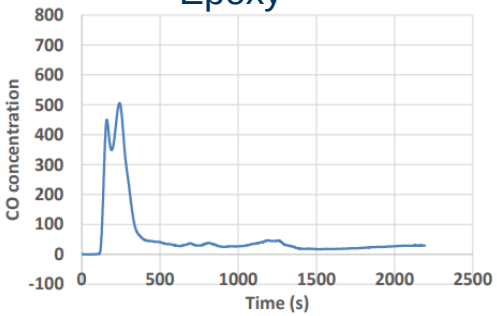
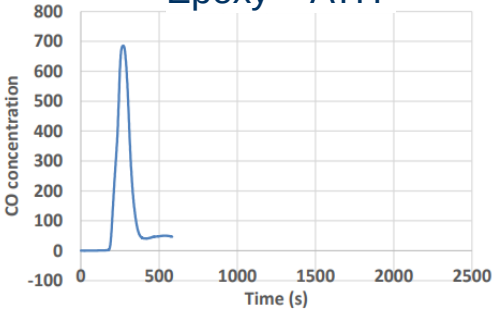
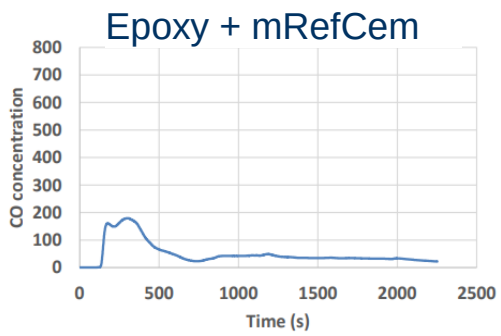
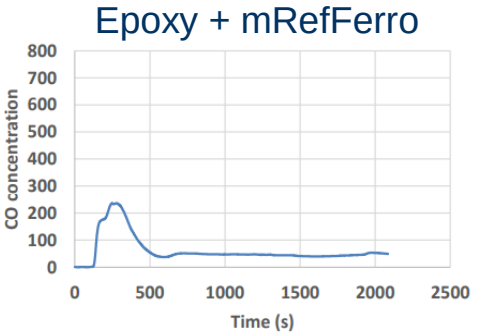
CO Concentration

4









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Potential Applications mRefFerro

- From the composition and measured properties, we anticipate the material to have potential for applications including:
- Conductive materials (electrostatic discharge applications)
- Fire retardant materials *
- Thermally insulating materials
- Extender replacement

* Ongoing investigations

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Thank you

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