CM Materials

ADVANCED MATERIAL FOR POWER ELECTRONICS AND ELECTRIC MOTORS

contact@cmmaterials.com
Problem

Large size

Magnetic cores are large. 30-50% circuit footprint covered by inductors and transformers.

Inefficient

~41% loss comes from inductors in a power converters. Two thirds heat generation happens in inductors and transformers.
Solution

- 5x higher resistivity -> Higher efficiency
- 50% higher induction -> Miniaturization

<table>
<thead>
<tr>
<th></th>
<th>Electrical resistivity (uohm-cm)</th>
<th>Magnetic Induction (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CleanMag/CleanLam</td>
<td>&gt;200</td>
<td>1.8-2.0</td>
</tr>
<tr>
<td>Incumbent metals/alloys</td>
<td>45-120</td>
<td>1.1-2.0</td>
</tr>
</tbody>
</table>

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(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2022/0392675 A1
(43) Pub. Date: Dec. 8, 2022

MAGNETIC MATERIALS AND MANUFACTURING

(54) Applicant: CM Materials Inc., Wilmington, DE (US)
(71) Inventor: Md Aminul Mehedi, Warrenton, PA

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Value Proposition

30-50%  size reduction of components

~50%  lower magnetic loss

Reduce cooling requirement

20-30%  lower cost for manufacturing by
CleanMag Magnetic core

- 30-50% smaller
- 50% more efficient
- Remove active cooling
- Reduced manufacturing cost

Inductor core
- Inverter
- DC-DC converter
- Transformer
- EMI Filter
- Power Factor Correction (PFC)
Inductor Performance

Lower Loss and Higher Induction Cores
Magnetic characteristics

CleanMag cores have 50% more induction relative to Sendust.

CleanMag cores have 200-300% more induction relative to MnZn Ferrites.

Driver for high current saturation leading to smaller magnetic components.
Magnetic characteristics

- **CleanMag** cores have 99.2% permeability up to 500 kHz
- We developed 60u as the first product
- We have ability to change the permeability values between 30 and 120
Magnetic characteristics

Core loss

- **CleanMag** demonstrated similar type of loss profile to Sendust core
- Potential to improve 50-60% more than that
Product Roadmap

We are improving the process and formulation every month

Tentatively ready final formulation by end of 2Q23

Capable to scale with off-the-shelf equipment
Sustainability

No critical elements
No Nickel or cobalt

CO2 emission
reduction by 1797 million Mt per year by 2050

Sustainable supply chain
Developed and manufactured in USA
Traction

Work in progress

10+ SAMPLE ORDERS

Potential sales funnel >$100M

Tier-1 and Tier-2 suppliers in consumer, industrial and EV
Product roadmap

2022
- CleanMag Magnetic core for power electronics

2023
- Magnetic core pilot production

2024
- Full production for magnetic core

2025
- CleanLam Steel production for electric motor

2027
- CleanLam Steel Pilot with customers for electric motor

CM Materials
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Board of Advisors

Professor Iqbal Husain

Ben Margolis

Ryan Spanheimer

Alan Crapo

NC STATE UNIVERSITY

Breakthrough Energy Fellows

Fredrikson & Byron

REGAL
Magnetic characteristics

Core loss

Graph showing core loss in mW/cm³ as a function of B (mT) at 100 kHz, 50 kHz, and 20 kHz.