

Metallic Nanocrystalline Material: Setting up the future of EVs and Hybrid industry

CBMM & Partners; Materials Technology, E Mobility & Smart Cities Workshop and Formula E race, HK.

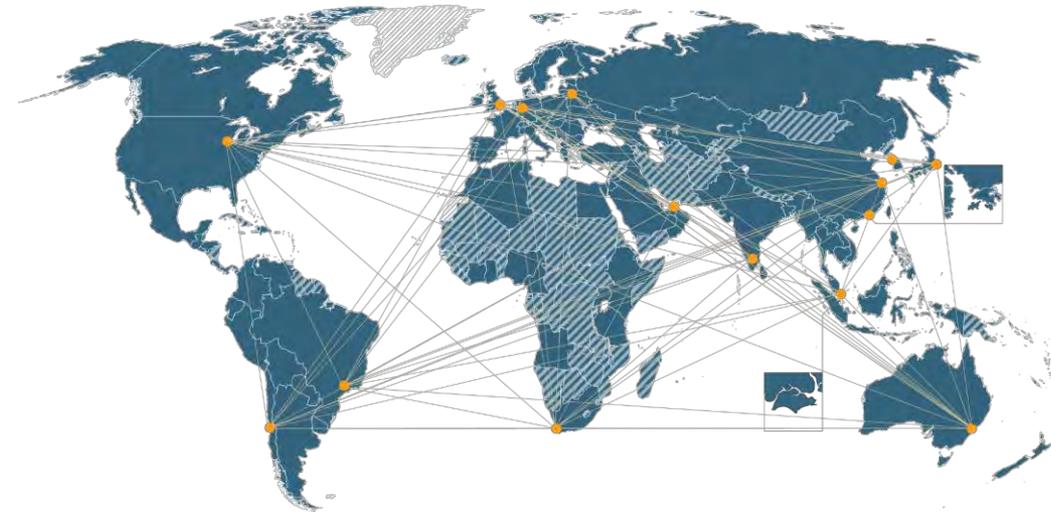
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Agenda



Presentation 20 min

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Contents

Where is the growth of EVs coming from?

How is MNC creating a more efficient, eco-friendly EV?

How to leverage the “green mindset” to shape innovation?

MNC

Metallic nanocrystalline materials (MNC) are an example of soft magnetic materials. Nanocrystalline alloys are materials made of **Iron, Silicon, and Boron** with additions of **Niobium and Copper**.

Soft magnetic materials

Soft magnetic materials are materials that are easily magnetized and demagnetized. They are used primarily to enhance and/or channel the flux produced by an electric current.

EVs and Hybrids

Electric Vehicles (EVs) and Hybrids are types of vehicle which use one or more electric motors for propulsion. Depending on the type of car, this can be powered by both gas and electricity.

High-end applications

Applications that require high measurement accuracy and additional requirements (more than 90% accuracy). E.g. EMC filters for high voltage systems.

EVs and Hybrids today and expected growth



2.0 million

EV and Hybrid sold in 2018 – light vehicle, units



79%

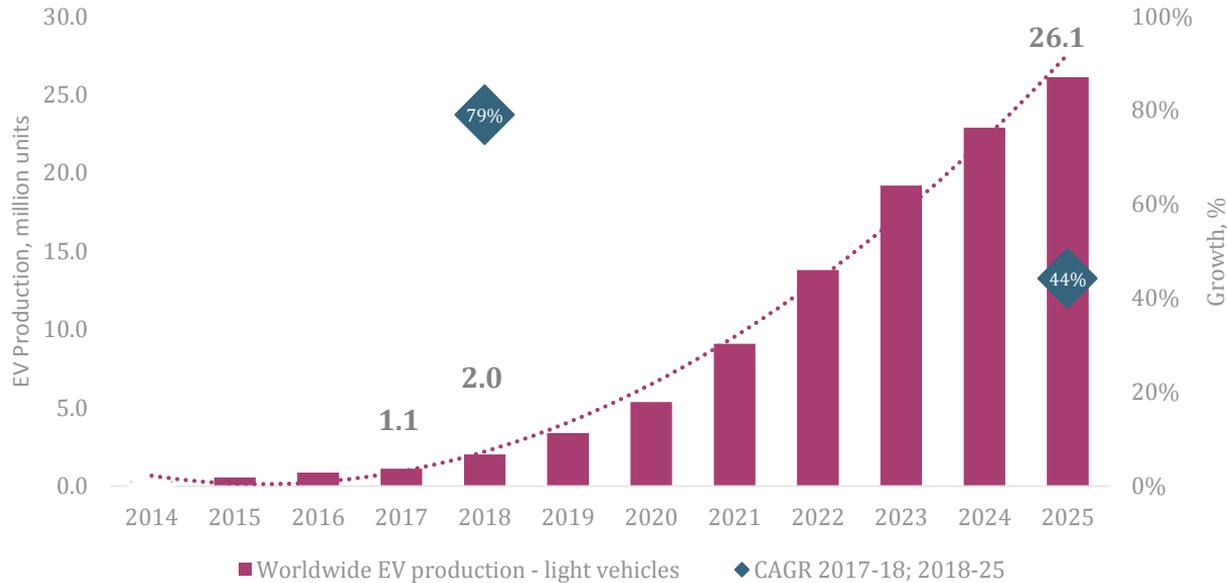
EV and Hybrid growth, 2017/18



44% CAGR

Expected growth to 2025 for light vehicles, units

EV and Hybrid light vehicle sales, million units
(2017-2025)



Technology advancements

Improvements in battery and range

Restrictions on CO2 emissions

EVs continued to witness double-digit growth with more than 2 million EVs sold in 2018

- By **2025**, public transport is expected to reach approximately 38 million units.
- This totals **55 million units** of EV and Hybrid light cars, medium- and heavy- duty trucks and buses.

Technology advancements

Technology is developing around available materials shaping the future of EVs and MNC adoption.

Improvements in battery and range

Assemblers are redirecting their R&D resources and focusing only on EV development, leaving white spaces for the adoption of more suitable soft magnetic materials.

Restrictions on CO2 emissions

This will cause conventional materials to be reduced, and the industry will have to start exploring more suitable types of materials, finding new alternatives, and migrating to them.



MNC DRIVERS FOR ADOPTION



While EV and Hybrid
technology is in
development, the industry
still has some unmet needs

1. Mechanical functionalities
2. Weight/size and efficiency ratio
3. Reliability

Usage, attributes, and unique selling points of MNC



5

Key devices for MNC usage



6

Different solutions where MNC can meet OEMs needs



5

Key advantages of MNC versus other soft magnetic materials

“As EVs become more dependent on electricity versus fossil fuel, the voltage required to function will be higher”.

- *Automotive R&D expert*

High-end applications such as EMC filters, HMI, and voltage control systems are required, providing room for high-grade MNC penetration.

Key devices for MNC usage on EVs and Hybrids

Device \ Solution	Human Machine Interface	Regenerative breaking system	Engine
Tape wound common mode chokes	Early stage		
EMC / EMI Filter	Early stage		
Earth Leakage Circuit Breaker (ELCB)			
Inverter or Converters		Early stage	
A/C Compressor			Early stage
DC/DC Reactors			Early stage

EV devices can benefit from MNC adoption

- 1) **HMI:** MNC's advantage is high permeability required for high frequency and voltage devices.
- 2) **Regenerative breaking system and Engine:** Both could benefit from the adoption of MNC due to its high-permeability, low corrosive force magnets, tenacity and capability to work at high temperatures.

Key devices for MNC usage on charging poles

Device \ Solution	Electric Vehicle Supply Equipment (EVSE)	Wireless charging coil – Induction coil
Tape wound common mode chokes	Early stage	Low adoption
EMC / EMI Filter	In adoption	Low adoption
Earth Leakage Circuit Breaker (ELCB)	Early stage	
Inverter or Converters		
A/C Compressor		
DC/DC Reactors		

Charging poles could also benefit from MNC adoption

- 1) Common mode chokes are being used (i) as a key component of electricity generation, and (ii) to isolate the charging and communication area.
- 2) The most common material used is Ferrite, making wireless charging coils expensive and bulky.

MNC

Permeability (f=1kHz)
High (90k – 120K)

Mechanical functionalities
High

Losses 0.2T/100kHz
280

Corrosion resistant

Tenacity

Early stage of adoption

High Performance Ferrite

Permeability (f=1kHz)
Low (2,500)

Mechanical functionalities
Low

Losses 0.2T/100kHz
900

High electrical resistivity

High penetration

Mature

Silicon Steel

Permeability (f=1kHz)
Medium (23K)

Mechanical functionalities
Medium

Losses 0.2T/100kHz
5K

Low electrical resistivity

High strength and hardness

High penetration

Green mindset and white spaces for MNC



Eco-friendlier EV

Assemblers are redirecting R&D and focusing on EV next gen



Charge and range

Advances pave the way for growth of EVs



WPT

Is the spearhead to smart cities, and will transform mobility

Eco-friendlier EV

The automotive industry faces more restrictions related to efficiency and low CO₂ emissions.

MNC is not perceived to be greener than Ferrite, but it results in a more efficient and eco-friendlier EV.

This could enable an entire electrical system to function by using energy more efficiently.

Charge and range

EV manufacturers are aiming to improve charging time and driving range.

- ✓ Opportunities for MNC lie in the properties of miniaturization, low energy losses, and high permeability.

WPT

To become a viable technology, coils will need to:

- ✓ become smaller
- ✓ Have high power transfer efficiency
- ✓ Have short charging times

Coils are exposed to non-favorable environmental conditions, so a material capable of maintaining mechanical functionalities is desired.

Key takeaways.

EVs industry is growing at **fast pace** and the development of suitable soft magnetic soft materials could **impact** even more, **boosting growth**

There is an **urgency** to improve mechanical functionalities, weight / size ratio and develop reliability and MNC could fulfill those needs.

For truly achieve Smart cities, the development and the adoption of Wireless charging, at least **in public transport** is needed.

THANK YOU

CONTACT DETAILS

Paulina Gross

Team Lead - Consultant

Paulina.Gross@Euromonitor.com

Helen Smith

B2B Practice Manager

Helen.Smith@Euromonitor.com