Miba's Eco-Mobility Activities – Components for Lower Emissions/Higher Efficiency

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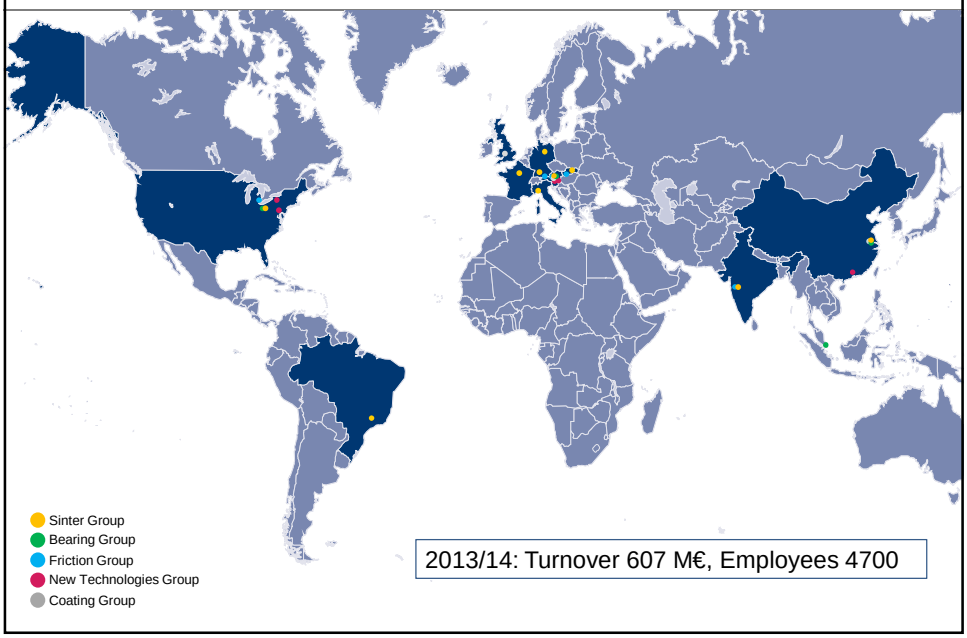
Outline

- Introduction Miba Group
- Fuel efficiency as a key requirement
- Miba's contribution: Selection of Components and Developments

Presented data contain results from projects funded by FFG bmvit

Global Supplier to the engine & vehicle industry

Miba's Global Network: 20 sites worldwide



- Sinter Group
- Bearing Group
- Friction Group
- New Technologies Group
- Coating Group

2013/14: Turnover 607 M€, Employees 4700

Miba Group

Overview on our Core Segments

Miba sintered components are high-precision and high-strength parts. They are used in engines, transmissions, steerings, brakes and shock absorbers of passenger vehicles.

Miba bearings support crankshafts in diesel and gasoline engines of heavy commercial vehicles, locomotives, power plants and ships. Their quality and reliability is critical to the functioning and durability of the engine.

Miba friction materials determine the performance of clutches and brakes. They are used in construction machines, tractors, trucks, cars, high-speed trains, motorcycles, aircrafts and wind turbines.

High-performance components for power electronics are a key to more efficient power trains as well as to the efficient and effective use of regenerative energy sources.

Miba Automation Systems is a specialist for µm-accurate, automated machining and positioning as well as for mobile processing of large components.

Miba coatings are used in components for engines, transmissions and other high-stress applications. They improve performance and energy efficiency and also save costs.

Future vehicle related requirements

Future fuel scenario

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The variety of fuels will increase –
but to utilize them efficiently will stay key requirement.
Independent from how their ratios will develop

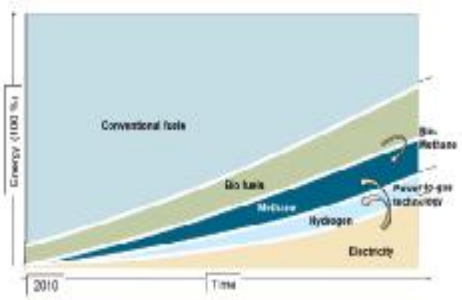

Figure 2.1 Scenarios / The indicative evolution of passenger road transport energy source and propulsion technology towards 2050 [based on: Volkswagen AG]

Figure 2.2 Coverage of transport modes and travel range by the main alternative fuels [Clean Power for Transport: A European alternative fuels strategy, 2013]

Source: ERTRAC-Roadmap "Energy Carriers for Powertrains," 27.02.2014

Efficiency requirements affect all of our markets

Miba's divisions and markets

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Components for high efficiency powertrains

Selected applications & developments

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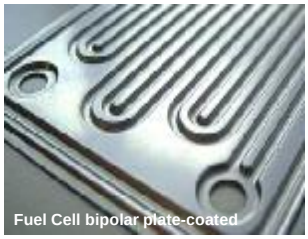
Al-Turbo charger wheel – wear protected

Piston Pin – DLC coated

Adaptive Coated Gear

High power density auxiliary drive – w/o RE magnets

Direct coated Conrod



Fuel Cell bipolar plate-coated

Low Friction coatings

Enabler to reduce internal losses of ICE's

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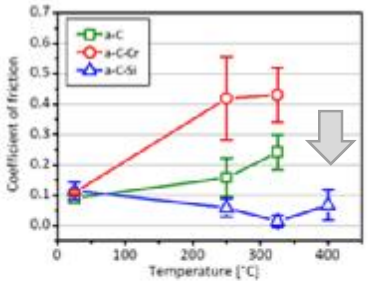
Characteristics:

- Silicon doped amorphous carbon coating
- Lowest friction coefficient at T 250 - 400°C

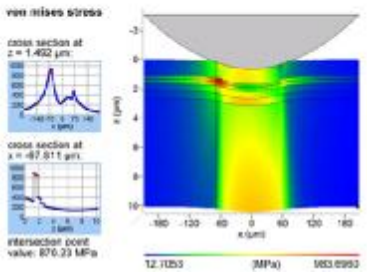
Potential Applications:

- Piston pin, piston ring
- Valve train, Valves



Simulation of coating architecture:

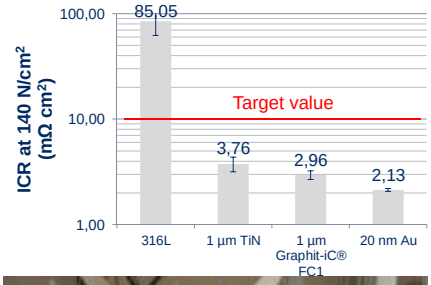
- Based on tribological characterization of coating for application related temperatures and load situations
- Simulation of coating architecture with the following outputs
  - Define optimized coating structure corresponding to loading, temperature, substrate material

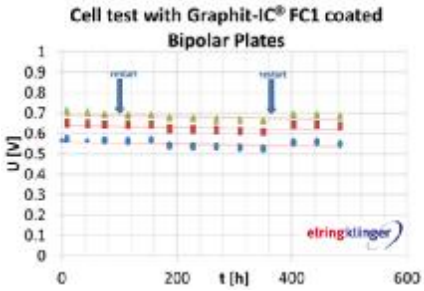


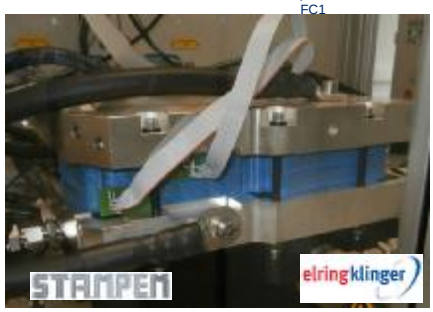
Coatings for metallic bipolarplates

Conductivity near the value of conventional gold

- US DoE targets for conductivity and corrosion resistance have been used to screen candidate coating materials
- First promising candidates are validated in single cell tests and stack tests with 1000 hr load cycling durability tests







Economic Coating processes

Wide range of systems from prototype to mass production

Batch System

- For coating development and prototypes
- Small batches for 100 to 1000 plates

In-Line System

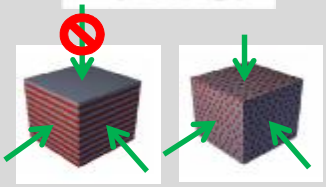
- Shortening of process time due to semi-continuous process
- Volumes: 10k to 100k plates per year
- Price in the range of 200-300 €/m² (Carbon multilayer coating, both sided)

High Volume System "HiVoLoCo"

- For volumes > 1 Mio. plates / year
- Optimized process for cleaning, cooling, automated handling and quality control
- Price in the range of EU/DoE targets (e.g. both-sided, <20 €/m² for 300.000 m²/year)

Soft Magnetic Composite (SMC) for electric motors

3D flux paired with specific topology

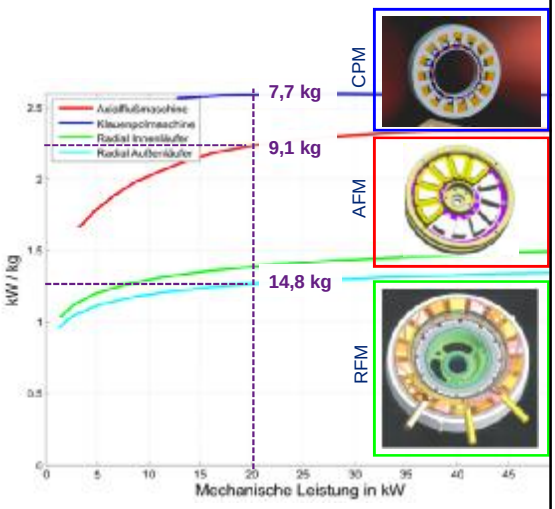


Steel SMC

Benefits:
- 3D flux possible
- Lower iron losses above f > 500 Hz

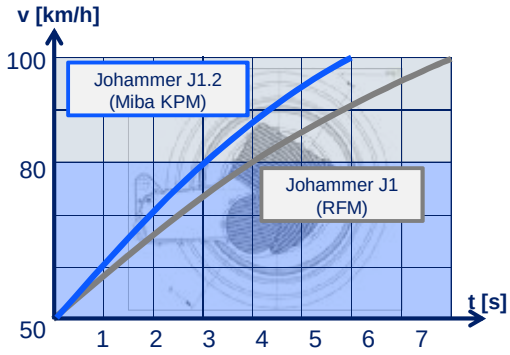
Restrictions:
- Lower mech. strength: 35-140 MPa (TRS)

Claw pole and axialflux topologies offer significant power to weight benefits

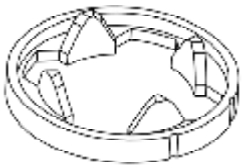


CPM for electric motor bike Johammer J1.2

~30% more torque in the same installation space

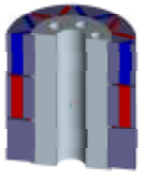


Design stator (SMC)



Stator pack

Assembly with windings



AFM demonstrator for auxiliary drives

High power/weight ratio w/o rare earth magnets

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Electric motor incl. power electronics

SMC components

Advantages:

- High performance cost / ratio
- High efficiency
- No rare earth magnets
- In-sensitive to environment temperature
- High overload capability
- Space for power electronics
- Easy to assemble / disassemble /recycle

Specifications DRM 120

- Power 600 W, Torque 1,0 Nm, Speed 6000 rpm
- DC link Voltage 24 V
- Outer Diameter 164 mm, length 77 mm (w/o shaft), rotor diameter 120 mm
- Weight ca. 2,5 kg

Components for high efficiency powertrains

Selected applications & developments

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Piston Pin – DLC coated

Adaptive Coated Gear

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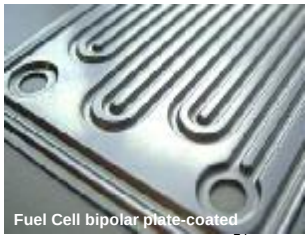

Fuel Cell bipolar plate-coated

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