Press Release

ILJIN and Fraunhofer ILT eliminate noise in electric cars

EHLA Brings Peace and Quiet to Electric Vehicles

The South Korean automotive supplier ILJIN was looking for a solution to a disturbing ping-noise occurring at the interface between the wheel bearing and the driveshaft. Working together with Fraunhofer ILT, the company developed an EHLA-based functional coating to address this issue, and has integrated it into a tailored application that is now making its way into mass production. This application demonstrates how a specific industrial challenge can lead to a laser process suitable for series production. It also shows that the solution lies not in the material alone, but in designing the component, surface, and manufacturing process to work together as a functional system.

An electric vehicle pulls away almost silently. Because the powertrain produces so little noise, acoustic effects that previously went unnoticed in conventional cars have become much more apparent. Clicking, creaking, and metallic knocking are far more noticeable inside electric vehicles, particularly at power transmission interfaces such as the connection between the wheel bearing assembly and the driveshaft.

Adam Dmytryszyn is Wheel Bearing R&D Director Europe at the South Korean automotive supplier and wheel bearing specialist ILJIN. His development team supports projects for European customers and is continually evaluating manufacturing technologies with potential for series production. At ILJIN, one issue that attracted particular attention was the so-called ping-noise phenomenon—a noise, vibration, and harshness (NVH) issue found in many modern vehicles.

As one of the world's largest manufacturers of wheel bearings, ILJIN produces millions of these components each year on highly automated production lines. Based on ILJIN's requirements and in close collaboration with the company, the Fraunhofer Institute for Laser Technology ILT developed an EHLA coating that specifically modifies the contact conditions within the wheel bearing assembly. EHLA (extreme high-speed laser material deposition) is an exceptionally efficient and material-saving coating technology developed at Fraunhofer ILT.

Cause at the wheel bearing unit–drive shaft interface

"The noise does not occur because a component breaks or comes loose, as some people assume when they hear it," explains Dmytryszyn. "It is caused by the extremely high forces acting at the contact surface between the wheel hub and the constant velocity joint." When an electric vehicle accelerates or recuperates energy, the high torque causes the driveshaft to deform slightly. As a result, the two steel surfaces at the interface initially stick together, then suddenly slip apart before sticking again. This stick-slip effect releases energy within fractions of a second, producing vibrations and noise that are clearly audible inside the vehicle.

Technically, it is only a tiny relative movement. In the vehicle, however, it sounds like a hard metallic crack—in other words, like a "ping." This effect is more pronounced in electric vehicles. They deliver high torque right from a standstill and, at the same time, run so quietly that even brief impulses from the chassis are noticeable.

This is precisely where traditional countermeasures reach their limits. "Greases reduce friction in the short term, but are displaced during operation and gradually lose their effectiveness," explains the wheel bearing expert. "Additional washers with low-friction coatings introduce extra components into an already confined interface. They increase complexity and cost, require additional installation space, and may contain PFAS-based materials that are now considered environmentally harmful."

An approach that only works in testing or masks individual noise disturbances is not sufficient for a wheel bearing that is manufactured in the millions and is also safety-critical. ILJIN sought a solution that not only meets the high quality and cost requirements, but also integrates seamlessly into existing production. The customer's acoustic problem thus became a question of design, materials, and process: Which functional coating alters the contact surface in such a way that the noise disappears without weakening the component itself?

Fraunhofer ILT and ILJIN launch a development project

Adam Dmytryszyn didn't get the decisive inspiration from a traditional automotive project, but rather by thinking outside the box. At the Hannover Messe 2023, Dmytryszyn saw an EHLA application presented by Fraunhofer ILT in which a thin metallic coating was applied with high precision and finished by simultaneous machining. The demonstration involved a plain bearing for wind turbines, but what immediately caught his attention was the underlying technology: a thin, durable coating with low surface roughness, a metallurgical bond to the substrate, minimal heat input, and high processing speed. This combination was exactly what was needed to solve the problem at the wheel bearing interface.

The contact made at the trade show soon developed into a joint development project. ILJIN contributed the component, system expertise, and requirements from automotive production, while ILJIN and Fraunhofer ILT jointly translated the functional requirements into specifications for the coating, including the coating material, thickness, heat-affected zone, and surface quality.

At Fraunhofer ILT, Viktor Glushych, group leader of the LMD Coating and Heat Treatment Group, and project manager Eduard Weisser took on the task of developing a robust and efficient EHLA process based on these specifications. Throughout the project, the ILJIN engineering team worked closely with the Aachen researchers, discussing technical questions, building a detailed understanding of the process, and jointly defining the next development steps—from initial prototype components to a process suitable for industrial production.

The feasibility study quickly revealed that the approach did not follow the principle of "select material, apply coating, problem solved." Applying a metallic coating to a component is only the first step. Crucial to the success was the technical depth with which the Fraunhofer ILT team tailored the process to the specific application: to the component, the surface, the powder material, the process parameters, the coating thickness, and the energy balance. Only through this interplay did a coating emerge that not only adheres but also functions under real-world loads, and is suitable for an industrial process. The Fraunhofer ILT team systematically investigated various coating variants, tested the adhesion to the bearing steel, determined the hardness and heat-affected zone, and transferred the process step by step from a simple sample to the actual wheel bearing.

ILJIN tested and compared the test samples produced by Fraunhofer ILT. To do this, ILJIN operates a test facility in Germany where it conducts tests under conditions similar to those encountered in vehicles. The results of the initial functional tests were incorporated into the final process design.

Precisely because the affected area is safety-critical, ILJIN set particularly high requirements for the coating process. The coating required a flawless, bond-type adhesion, but the process heat was not allowed to damage the underlying steel. At the same time, it had to behave under high surface pressure in such a way that the contact surface would fulfill its function over the entire service life of a vehicle.

Noise disappears, interface remains stable

"For this application, EHLA was particularly attractive because it combines short process times, low unit costs, and straightforward integration into existing production lines," says Glushych. "At the same time, it produces a metallurgically bonded, PFAS-free functional coating tailored specifically to ILJIN's requirements for this interface and superior to existing solutions in many respects."

In extreme high-speed laser material deposition (EHLA), the metal powder does not reach the surface in a cold state. Instead, the laser beam melts the powder before it strikes the component. This enables high deposition rates while minimizing heat input into the base material. That combination proved decisive for the wheel bearing application.

The surface had to be specifically functionalized, but the steel underneath had to retain its mechanical properties. The result was a thin functional layer that does not act as an additional component at the interface but instead becomes an integral part of the wheel bearing surface. "This makes the approach/process particularly interesting for applications where high demands on performance and component safety must be balanced against strict cost and quality criteria," explains Glushych.

For ILJIN, it wasn't just technical feasibility that mattered, but also the path to integrate the process into the production line. A wheel bearing is not a laboratory demonstrator, but a component produced in very high volumes and at a strict cycle time. The coating therefore had to be successfully applied to the fully assembled wheel bearing, integrated into an existing highly automated process, and meet existing production cycle times. After joining, assembly, and testing, there could be no slow, time-consuming special process that would become a bottleneck for the entire line.

From the outset, the Fraunhofer ILT team thus focused on applying the coating to the fully assembled wheel bearing within just a few seconds. Careful process design eliminated the need for subsequent mechanical finishing. Even the surface texture of the coating became part of the solution. Rather than proving disadvantageous, its roughness helped retain lubricants and protective media, further stabilizing the contact interface between the wheel hub and the driveshaft.

From the lab to automotive production

Extensive bench tests and vehicle trials ultimately determined whether the approach would succeed. The key question was not simply whether the EHLA coating met the material specifications established during the feasibility study. It also had to maintain its function after assembly and under repeated load cycles, corrosion, contamination, temperature fluctuations, and prolonged vehicle operation/driving cycles.

The coated contact surface met these requirements. "In all of the long-term tests we have conducted internally and together with our customers, we have not observed any problems with the applied coating," says Dmytryszyn. "It allowed the necessary relative movement while significantly reducing damage to the mating surface. The unwanted ping noise disappeared, and the interface remained fully functional. Because the coating is so thin, the solution can be incorporated directly into many existing customer designs without requiring modifications to adjacent components."

For Fraunhofer ILT, the project also marks another important milestone in technology transfer. Following established EHLA applications such as brake-disc coatings, this project represents another successful transfer of technology developed in Aachen into automotive series production. Comprehensive testing and qualification have now resulted in the first production order. ILJIN is has begun to mass-produce the coated wheel bearings in the millions. The Fraunhofer ILT team continues to support the company as the process is transferred into production, helping to ensure stable, repeatable, and quality-assured manufacturing.

This achievement is anything but a given. For safety-critical automotive components, successful laboratory results alone are not sufficient. The process must also receive customer approval, demonstrate consistently controllable quality, and meet demanding production cycle times. Successfully meeting these requirements shows that the work carried out by Viktor Glushych, Eduard Weisser, and the ILJIN team extended well beyond a conventional feasibility study.

"By bringing EHLA into series production for wheel bearings, we have demonstrated that the technology performs reliably even under the demanding conditions of automotive manufacturing," says Glushych. "The next step is to transfer this knowledge to additional products—not as a standard solution, but as the starting point for new functional coatings tailored to specific applications."

The ILJIN project demonstrates how Fraunhofer ILT and its partners can successfully transfer technology into industrial series production. What began as an unwanted noise at a critical interface has resulted in a laser-based manufacturing process that is now entering highvolume automotive production. Looking ahead, ILJIN plans to apply EHLA to functional coatings in additional product areas, including robotics as well as chassis and drivetrain components—wherever precisely tailored contact properties can provide a technical advantage.

Image 1: The fully coated Generation 3 wheel bearing unit from ILJIN: The EHLA functional layer is applied to the ring surface where the interface with the drive shaft is formed in the vehicle. It specifically modifies the contact surface without introducing an additional component into the confined installation space. © ILJIN GmbH.

Image 2: In extreme high-speed laser material deposition (EHLA), metal powder is melted by the laser beam and applied to the component as a thin functional layer. For the wheel bearing application, it was crucial that the coating process be cost-effective and efficient, and introduce minimal heat into the base material. © Fraunhofer ILT, Aachen, Germany.

Image 3: The cross-section reveals just how thin the applied functional layer is. In the feasibility study, Fraunhofer ILT investigated various coating materials, process strategies, and process parameters to adapt the coating to the safety-critical wheel bearing. © Fraunhofer ILT, Aachen, Germany.

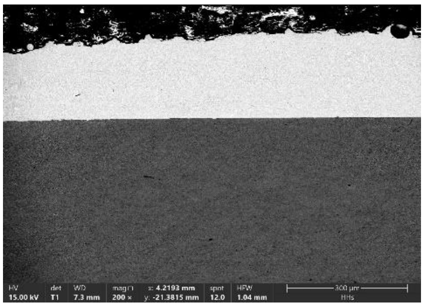

Image 4: A microscopic view of the edge zone: The EHLA coating is designed to bond firmly to the metal while exerting only minimal thermal influence on the bearing steel beneath it. It was precisely this balance between strong bonding and low heat input that led to the selection of the EHLA process for this application. © Fraunhofer ILT, Aachen, Germany.

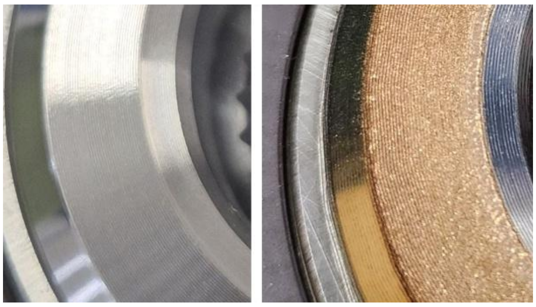

Image 5: Not all roughness is a disadvantage: The investigations showed that the structure of the EHLA layer can absorb protective and lubricating substances, thereby contributing to a stable contact surface. © LJIN GmbH.

Image 6: At the AKL – International Laser Technology Congress 2026 in Aachen, Adam Dmytryszyn, Director of Wheel Bearing R&D for Europe at ILJIN, presented how Fraunhofer ILT collaborated with ILJIN to develop an EHLA-based functional coating for wheel bearings, from the first prototype through to industrial application. © Fraunhofer ILT, Aachen, Germany.

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With more than 30,000 employees at 74 institutes and independent research units in Germany, Fraunhofer operates with an annual budget of 3.6 billion euros. Contract research, Fraunhofer's mainstay, generates 3.2 billion of this budget.

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