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China Speed: Q&A with Polaron

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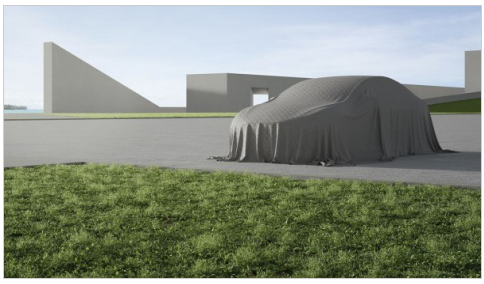
How AI-driven materials development is accelerating Western automakers' competitiveness against Chinese rivals.



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Over the past few years, the automotive industry has been preoccupied with a deceptively simple question: how can Western carmakers match the pace of their mainland Chinese rivals? The discussion is often framed with vehicle development timelines, engineering costs and manufacturing efficiency in mind. Yet, beneath these headline metrics lies a less visible factor that increasingly shapes competitive advantage — the speed at which companies can develop, validate and deploy new materials.

From batteries and coatings to lightweight alloys and joining technologies, materials decisions influence almost every stage of vehicle development. Historically, however, materials engineering has been a stubborn bottleneck. Development cycles have relied heavily on trial-and-error experimentation, fragmented datasets and lengthy validation processes, often stretching programs by months rather than weeks.

This is beginning to change. Advances in AI, computational modeling and data-driven engineering are allowing manufacturers and suppliers to reduce reliance on iterative testing and move toward more predictive development workflows. The result is not necessarily a single breakthrough material, but a systematic compression of engineering timelines through faster characterization, qualification and optimization.

The contrast with mainland China is becoming increasingly apparent. While mainland Chinese manufacturers have benefited from scale and engineering capacity, they have also shown a growing willingness to operationalize AI-enabled development methods across organizations rather than confining them to pilot projects. In many cases, the competitive advantage stems as much from organizational execution as from technology itself.

For Western original equipment manufacturers and suppliers, the challenge is therefore not simply adopting new tools but embedding them into standard engineering practice. To explore how AI-driven materials innovation could reshape automotive competitiveness, we spoke to Isaac Squires, CEO and founder of Polaron, an AI startup spun out of Imperial College London that uses generative machine learning to accelerate the design and optimization of advanced materials.

Isaac Squires

[Source: Polaron]

The following is an edited transcript of the conversation.

S&P Global Mobility: Much of the discussion around China Speed focuses on vehicle development timelines, but how significant is the role of materials innovation and materials optimization in enabling faster product development?

Isaac Squires: It's foundational. Automotive engineering is a multilength-scale design problem, from atoms and crystal structures, through microstructure and components, up to full packs and vehicles — materials sit at the centre of that chain. Materials decisions shape every part of a vehicle programmes, from battery electrodes to coatings, to structural alloys, joints and welds. Today, much of materials science still depends on manual trial-and-error and "human-in-the-loop" validation, which creates a major bottleneck for development timelines.

What's changing now is that teams can increasingly compress work that used to take weeks or months using AI, modelling and data-driven methods: faster qualification, faster characterisation, faster iteration, faster design. In practice, the speed gains come less from a single breakthrough material and more from systematically reducing trial-and-error by using higher-signal data and more predictive workflows earlier in the programmes.

Are mainland Chinese OEMs approaching materials engineering, battery development or simulation-led design differently from Western OEMs? If so, where are the biggest differences visible today?

There are still plenty of shared challenges — materials innovation everywhere has historically leaned heavily on trial-and-error and expert intuition. Mainland Chinese teams often have a lot more manpower and so have been able to iterate faster. But one difference that's increasingly visible is organisational commitment to model-driven and data-driven development: dedicated teams being built around AI-for-science, faster iteration cycles and tighter coupling between design, test and manufacturing feedback. This has been a real investment from these teams. Where that shows up most clearly is in willingness to operationalize these methods, not just run pilots.

Where do current Western materials development and validation processes create the greatest delays, and how much potential is there for AI and computational modeling to accelerate those cycles?

The biggest delays are usually at the interfaces: when qualitative judgment, disconnected datasets and slow validation loops force teams into repeated "wait-and-see" iterations. Materials teams often spend enormous time interpreting noisy signals, reconciling inconsistent test data, relying on intuition and running expensive experiments or simulations.

AI's potential is substantial because it can learn from complex data and turn it into measurable signals. Once teams can quantify behaviours that were previously hard to observe or compare, they can start to design them directly, rather than iterating by intuition. Leading to data-driven design cycles which create orders-of-magnitude speed-ups across length scales, from atomistic mechanisms and microstructure through components and full systems, and finally makes it possible to connect those scales in one consistent, predictive workflow.

How important will AI-driven materials discovery and optimization become in helping Western OEMs close the competitiveness gap with mainland China over the next decade?

The story of human civilization has been the story of materials development — from the Stone Age and Iron Age to the Silicon Age. Materials and materials processing fundamentally underpin the seismic technological shifts, and if the West is to compete, it will have to be through moving faster on materials-led innovation.

In batteries and electrification, that could mean accelerating solid-state, sodium-ion, lithium-sulphur, dry processing, multilayer coatings or whatever comes next.

But the key here is adoption at scale. Stand-alone accuracy improvements matter less than embedding AI into the standard processes — so it consistently changes decisions across programmes, sites, and time — and therefore across the industry.

What aspects of the mainland Chinese development model are most transferable to Western OEMs from a materials and engineering perspective, and which structural or organizational barriers remain hardest to overcome?

Most transferable: treating AI adoption like an engineering programmes, not a tech demo — pick high-value decisions, define success criteria, and build and iterate quickly. Invest in the motion.

Hardest barriers: large-company inertia. Closing the gap is less about whether the technology works and more about whether these companies are willing to be brave: invest early, grant real autonomy to the teams closest to the problem, and protect their ability to move fast. That also means being open to innovating with partners, accepting mistakes as part of the learning loop, and backing the changes needed to turn pilots into standard practice across the organisation.

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