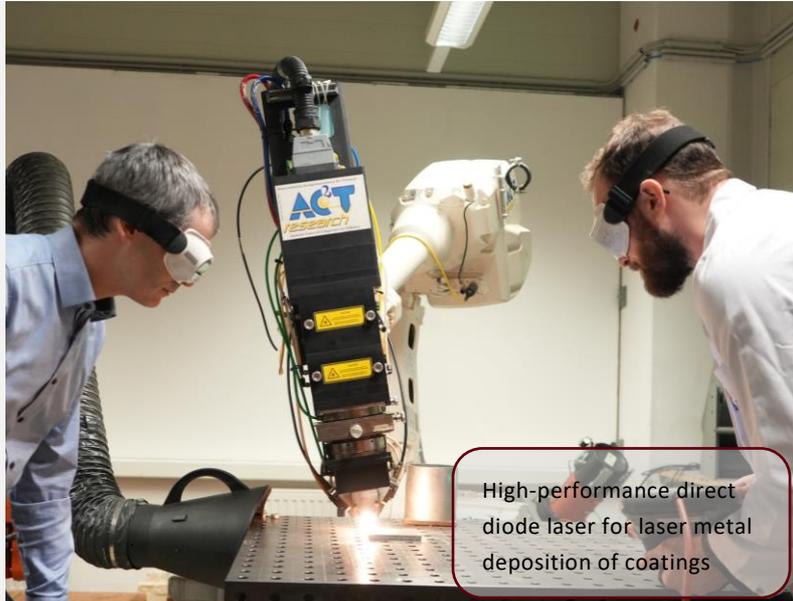


**InTribology2
Excellence Centre of Tribology**

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Safe and sustainable materials and chemicals for tribosystems
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strategy



HIGH-PERFORMANCE MEETS SUSTAINABILITY: NOVEL IRON ALUMINIDES COATINGS FOR WEAR PROTECTION

AC²T HAS DEVELOPED BREAKTHROUGH COATINGS THAT ARE SAFE AND SUSTAINABLE BY DESIGN WHILE MATCHING THE PERFORMANCE OF THE BEST TECHNOLOGIES CURRENTLY AVAILABLE.

The metals industry is a major contributor to greenhouse gas emissions, using enormous amounts of energy to extract and process raw materials. With metal production accounting for around 40% of industrial emissions and with the demand for raw materials far outpacing what can be recycled, there is an urgent need for more sustainable solutions, especially since ~3% of the world’s total energy demand is consumed for reproducing worn parts, which yields a potential of emission reduction in the Gt CO_{2eq} range.

AC²T has developed a new type of wear protection coating using iron aluminides. These materials remain stable at temperatures up to 600°C and offer excel-

lent resistance to wear and corrosion. Instead of relying on critical and scarce elements with a high environmental impact like cobalt, nickel, or chromium, our coatings use more abundant materials, contributing to both environmental and economic sustainability. Using laser metal deposition as a modern additive manufacturing technique, we apply our iron aluminide-based coatings onto different surfaces. By adding elements such as boron, carbon, silicon, or a combination of titanium and boron, we significantly increase the coating’s hardness and its durability in terms of wear resistance. Instead of adding these elements, one further step towards sustainability is achieved by reinforcing the coating with recycled hard-metal scrap to increase the

SUCCESS STORY

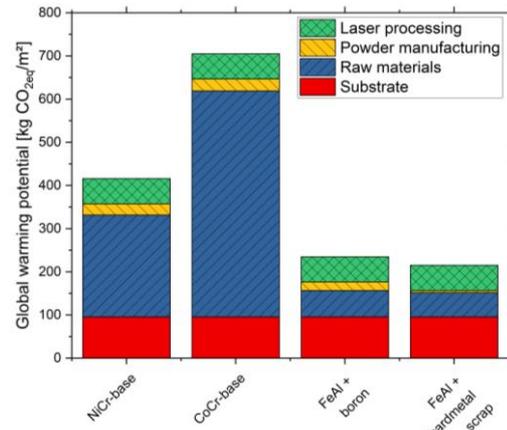
coating's hardness and wear resistance. This not only enhances the wear performance and the lifetime but also turns waste into a valuable resource.

How do these coatings work? We showed that iron aluminide coatings form under abrasive wear conditions a protective, mechanically mixed layer with the abrasive that slows down further damage at hardness levels below 400 HV10 or is sufficiently protected by the present hardphases (borides or hardmetal scrap particles) even when exposed to high temperatures. Thanks to this behavior, the developed iron aluminides outperform currently used nickel- or cobalt-based coatings, which rely on critical raw materials and have a high environmental impact.

Impact and effects

The developed coatings show multiple benefits for industry. Thanks to their excellent wear resistance, particularly at high temperatures, industrial components can be kept longer in operation, thus reducing maintenance and replacement costs. Additionally, the increase in durability results in fewer natural resources as well as energy for processing being needed, thus reducing overall environmental impact, especially the product carbon footprint. Since the developed iron aluminide claddings feature all 4 approaches for increased materials sustainability, i) lightweighting and materials replacement, ii) lifetime

increase, iii) production yield via laser cladding and iv) enhancing recycling, the performance aligns well with sustainability.



Global warming potential (CO_{2eq}) emitted for 1 m² of wear plates with coatings of the novel iron aluminides in comparison with currently used coating systems.

Our iron aluminide coatings are capable of outperforming traditional wear protection solutions in harsh, high-temperature environments. Therefore, they are ideal for industries like mining, cement production, and heavy materials handling, where wear resistance, stability at high temperatures, and high-temperature corrosion resistance are critical. With these advancements, AC²T is not only contributing to protect machinery but also takes a big step towards a more sustainable industry.

Project coordination (Story)

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