

Popular science summary of the PhD thesis

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Title of the PhD thesis	Surface Engineering of Titanium Alloys for Biomedical Applications
PhD school/Department	DTU Construct

Science summary

* Please give a short popular summary in English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology.

Titanium is widely used for medical implants due to its excellent biocompatibility and corrosion resistance, yet its poor wear performance limits broader applications. As a result, current artificial joints still rely on cobalt–chromium alloys, despite their economic drawbacks and potential toxicological concerns.

This PhD project explores low-temperature surface hardening to improve the wear and corrosion resistance of titanium without compromising its protective oxide layer or metallic appearance. By precisely controlling gas atmospheres and temperature, nitrogen and oxygen were introduced into the surface to form hard diffusion layers. These modified surfaces exhibit high hardness, effectively resisting wear and tribo-corrosion under conditions representative of the human body.

Both commercially pure titanium and the widely used Ti6Al4V alloy were studied. The developed treatments demonstrated performance levels comparable to cobalt-chromium materials. The work provides new insight into the underlying mechanisms of diffusion-based hardening and hydrogen interaction during nitriding. These findings not only support the development of safer and more durable biomedical implants but also open opportunities for applying surface-hardened titanium in other demanding environments such as aerospace and energy systems.

Please submit the summary to the department PhD coordinator together with your thesis