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3D Hydrogen mapping in oil-filled porous steel gears for self-lubrication

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Fluid-based lubrication systems in gearboxes are ubiquitous in present-day mechanical engineering to reduce power losses during operation, increase service life and efficiently dissipating heat. By integrating the volume of lubricating oil required for contact lubrication into the pores of a sintered component where it can extrude under load, the lubrication and sealing system can be significantly simplified or even completely eliminated. Oil-impregnated sintered friction bearings are commercially available, but the load bearing capabilities of these systems are not sufficient for the contact surfaces of toothed gears. In a novel approach, materials for gear fabrication were designed, targeting a specific porosity to enable oil impregnation of gears. Such impregnated gears will yield an improvement in tribological properties compared to conventional dry or once-lubricated systems while retaining their original mechanical strength, thus enabling to optimize the design of future gearboxes. The process of filling such porous steel gears with oil is currently being investigated. To understand this process and investigate the homogeniety of the distribution of oil in the gear, neutron imaging measurements were performed. Due to the flat sample geometry, neutron computed laminography was applied to spatially map the oil distribution in 3D for both filled and tested gears. Revealing inhomogenieties from filling and low oil contents in the state after successful extrusion under load.

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