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Advancing Hydrogen Production Through Additive Manufacturing: Optimising Structures of High Performance Electrodes

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Abstract : The quest for sustainable energy sources has driven significant interest in hydrogen production as a clean and efficient fuel. Alkaline water electrolysis (AWE) has emerged as a prominent method for generating hydrogen, necessitating the development of advanced electrode designs with improved performance characteristics. Additive manufacturing (AM) by laser powder bed fusion (LPBF) method presents an opportunity to tailor electrode microstructures and properties, enhancing their performance. This research proposes investigating the AM of electrodes with different lattice structures to optimize hydrogen production. The primary objective is to employ advanced modeling techniques to identify and select two optimal lattice structures for electrode fabrication. LPBF will be used to fabricate electrodes with precise control over lattice geometry, pore size, and distribution. The performance evaluation will encompass energy consumption and porosity analysis. AWE will assess energy efficiency, aiming to identify lattice structures with enhanced hydrogen production rates and reduced power requirements. Computed tomography (CT) scanning will analyze porosity to determine material integrity and mass transport characteristics. The research aims to bridge the gap between AM and hydrogen production by investigating lattice structures potential in electrode design. By systematically exploring lattice structures and their impact on performance, this study aims to provide valuable insights into the design and fabrication of highly efficient and cost-effective electrodes for AWE. The outcomes hold promise for advancing hydrogen production through AM. The research will have a significant impact on the development of sustainable energy sources. The findings from this study will help to improve the efficiency of AWE, making it a more viable option for hydrogen production. This could lead to a reduction in our reliance on fossil fuels, which would have a positive impact on the environment. The research is also likely to have a commercial impact. The findings could be used to develop new electrode designs that are more efficient and cost-effective. This could lead to the development of new hydrogen production technologies, which could have a significant impact on the energy market.

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