# Functional Layers for Ni-Fe Metal-Support Protonic Ceramic Fuel Cells

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論 文 名　：Functional Layers for Ni-Fe Metal-Support Protonic Ceramic Fuel Cells (Ni-Fe 金属支持酸化物プロトン伝導燃料電池のための機能層)

区　　分　：甲

## 論 文 内 容 の 要 旨

This study focuses on developing and employing functional layers in Ni-Fe metal-supported protonic ceramic fuel cells (PCFCs). It addresses key challenges such as high internal resistance, current leakage, and insufficient reaction at the electrode/electrolyte interface by utilizing advanced materials and fabrication techniques.

Chapter 1 introduces the background of PCFCs, explaining their operating principles, challenges, and the importance of proton-conducting oxide electrolytes. It highlights the need for the functional layer to enhance electrochemical reactions. It also discusses the advantages of pulsed laser deposition (PLD) for fabricating thin film as a functional layer at the electrode/electrolyte interface.

Chapter 2 explores the development of BZCY-PrDC double columnar as a cathode functional layer (CFL) to enhance cathodic performance. This structure improves ohmic and interfacial resistance through lattice defects at the boundary of two columns. This double-columnar design leads to high power density compared to single-column CFL or PCFC without CFL.

Chapter 3 focuses on the use of La(Sr)$ScO_3$ (LSSc) based CFL to decrease interfacial resistance and improve proton conductivity. The oxygen vacancies induced by the dopant enhance hydration

capacity and mobility, improving performance. The thin LSSc CFL fabricated by the PLD technique ensures uniformity and a thin layer at the interface in metal-supported PCFCs.

Chapter 4 investigates the insertion of palladium (Pd) as an anode functional layer (AFL) to address the high IR loss of PCFCs. It focuses on several advantages of Pd such as hydrogen oxidation reaction (HOR) catalytic activity, which improves anode performance. The uniform and porous Pd AFL also facilitates gas diffusion, enhancing the efficiency of the anodic side of PCFCs

In Chapter 5, above results are summarized, and future prospects is given.

This thesis provides insights into advanced FL for PCFCs, offering solutions to key challenges and demonstrating significant improvement in power generation for metal supported PCFCs