A Multi-Port Bidirectional Power Conversion System for Reversible Solid Oxide Fuel Cell Applications

Reversible Solid Oxide Fuel Cell/Electrolyser Cell (SOFC/EC) technology is an attractive solution for high energy storage system in the utility grid. However, the wide range of voltage and low power of single SOFC/EC stack make it difficult to design the power conversion system for SOFC/EC storage system. In this paper, a new power multiport bidirectional conversion system is proposed to connect multiple SOFC/EC stacks with the utility grid. The converter structure contains a multi-port structure with two conversion stages. The two-stage conversion structure is first analyzed to address the wide-range of SOFC/EC stack’s voltage. The high-step-down CLLC resonant converter is implemented to achieve efficient voltage transformation, and the interleaved buck converter is employed as the second stage to control the voltage of SOFC/EC stack within a wide range. The derivation of the multi-port structure is introduced, and the control strategy of proposed conversion system is also discussed in this paper. The proposed conversion system enables a flexible control for the application of multiple SOFC/EC stacks. The feature of the proposed system is verified by the experiments from a down-scale prototype.