Freeform Design of Flow Channels in Redox Flow Batteries by Topology Optimization

K. Yaji[†*], C-H. Chen[†], S. Yamasaki[†], S. Tsushima[†] and K. Fujita[†]

[†] Department of Mechanical Engineering, Graduate School of Engineering, Osaka University
2-1, Yamadaoka, Suita, Osaka 565-0871, Japan
*e-mail: yaji@mech.eng.osaka-u.ac.jp,
web page: http://syd.mech.eng.osaka-u.ac.jp/index-en.html/

ABSTRACT

We present a novel design approach of flow channels in redox flow batteries (RFBs). RFB is one of the promising next-generation storage system for renewable energy resources such as solar and wind. It is widely known that the performance of RFB depends on the flow channel configuration. We therefore focus on generating novel flow channels for RFBs by topology optimization, which has attracted attention as a powerful design tool based on mathematical optimization. The attractive feature of topology optimization is that a topology-optimized configuration can be led from a blank design domain. That is, freeform design of the flow channels can be realized without setting a promising initial guess in advance. Our research group has recently proposed a topology optimization method for the design of flow fields in RFBs with the incorporation of a two-dimensional simplified model [1]. As a more comprehensive research, the aim of this study is to construct a three-dimensional topology optimization method for the flow fields.

In this study, we formulate a topology optimization problem in the negative electrode of a RFB system, for achieving maximum charging efficiency. We demonstrate that the topology-optimized flow channels can be obtained in the numerical examples.

REFERENCES

[1] Yaji, K., Yamasaki, S., Tsushima, S., Suzuki, T. and Fujita, K. Topology optimization for the design of flow fields in a redox flow battery. *Struct. Multidisc. Optim.* (2018) **57**:535–546.