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C3Po1C-08: Design and experiment of Inclined labyrinth seal for transferring cryogenic fluids to rotating superconducting machines

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Superconducting motors and generators are known to have advantages in lightening weight and improving efficiency compared to normal conducting machines, and researches on superconducting motors using liquid hydrogen also have recently been widely conducted. To cool the superconducting rotating machines, a cryogenic rotary coupling is required to supply and return the cryogenic fluid and the development of a sealing structure in the cryogenic rotary coupling is essential to minimize fluid leakage.

This study describes the design and performance evaluation of non-contact Labyrinth seals, not contact-type seal structures, in which power loss and thermal load due to friction occur. Inclined multiple flow paths are applied to further minimize leakage in the high-speed rotor due to the centrifugal force. Prior to fabrication, the leakage flow rates are simulated for the various shapes of the flow paths and the rotational speed using the Computational Fluid Dynamics (CFD) method. The performance of the seal designed using liquid nitrogen is evaluated by measuring the leakage flow rates at a given differential pressures using a performance evaluation apparatus. The results of the study will be used in the development of cryogenic rotary coupling with supply and return flow paths at cryogenic temperature.

Authors: KIM, Seokho (Changwon National University); KIM, Yubin (Changwon National University)

Co-authors: LEE, Changhyung (Changwon National University); Dr SIM, Kideok (SuperGenics); KIM, Kihwan (Changwon National University); HAHN, Seungyong (Seoul National University)

Presenter: KIM, Yubin (Changwon National University)

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