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Study of Rotational Stability in the HTS Magnetic Bearing Rotor Incorporated the Secondary of the Induction Motor

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The magnetic bearing using the pinning effect of the high-temperature superconductor (HTS) has been developed. The rotor composed of the permanent magnet levitates without control with levitation gap g = 10 mm due to the pinning effect of HTS. In order to give the function of the secondary side of the induction motor (IM) to the magnetic bearing, a force other than the rotation direction due to torque is applied to the magnetic bearing rotor. Thereby, it makes the levitation unstable. In order to study the instability, the inclining angle during the rotation of the HTS magnetic bearing rotor is measured. The HTS is YBaCuO. The rotor is rotated by the rotating field generated by the stator. The rotor is composed of the ring type permanent magnet, the yoke, aluminum, and magnetic shield, and the diameter is 100 mm, the weight is 710 g.
In this experiment, the inclining angle of the rotor at n = 400, 600rpm is measured with the IM running. A three-phase current is applied to the IM, and after the rotor reaches an arbitrary rotational speed, the inclination of the rotor is measured with a transmission laser to evaluate the stability. From the experimental results, average angle due to the vibration of the rotor are 1.23°at n = 400, and 2.52°at n = 600. The average angle at n = 600 rpm is 2.05 times the average angle at n = 400 rpm. This is because resonance occurs due to the natural frequency of the rotor around n = 600 rpm. The weight and the equivalent spring coefficient of the rotor is 2830 N / m, so that resonance occurs at n = 603 rpm (calculated value). Therefore, the inclining angle at n = 600 rpm increased more than at n = 400 rpm.

Primary author: MINAMITANI, Marin (Kansai University)

Co-authors: Mr TANIGUCHI, Rento (Kansai University); OHASHI, Shunsuke (Kansai University)

Presenter: MINAMITANI, Marin (Kansai University)

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