Oral | Applications: Motors and others

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[O6] Applications

Session Chair: Dr. Yusuke Hirayama(National Institute of Advanced Industrial Science and Technology)

Invited

10:45 AM - 11:05 AM JST | 1:45 AM - 2:05 AM UTC

[O6-1] High-Speed and High-Efficiency Cooling Fan Motor with Nd-based Bonded Magnet and Fe-based Nanocrystalline Soft Magnetic Alloy

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Keywords：Cooling Fan Motor、Nd-based Bonded Magnet、Fe-based Nanocrystalline Soft Magnetic Alloy

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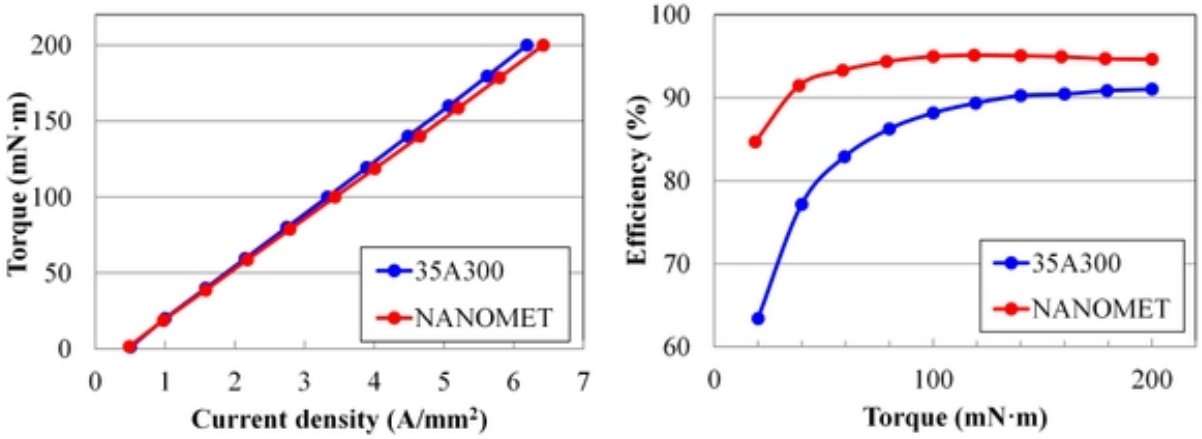
With the advancement of fifth-generation mobile communication systems (5G), the volume of data transmission has increased significantly, necessitating the enhancement of communication base station servers for high-speed processing. However, as processing speeds increase, heat generation within servers has become a critical issue, making improvements in cooling system performance an urgent challenge.
Among various cooling systems, cooling fans are widely used in servers due to their relatively high performance and low cost. Enhancing the performance of cooling fans requires increasing both airflow and static pressure, and thus, their drive motors should have increased output power. However, increasing the motor's rotational speed and torque also leads to greater heat generation, making loss reduction—i.e., improving efficiency—essential. Despite this, conventional cooling fan motors have primarily been designed with cost reduction in mind, and studies on high-power and high-efficiency designs have been extremely limited.
To address these challenges, this paper investigates methods for achieving higher output power and efficiency in cooling fan motors from the perspective of magnetic materials. First, Nd-bonded magnets were employed to achieve over 90% efficiency, even at high rotational speeds. Additionally, polar anisotropic magnetization was utilized to maximize magnet flux and enhance torque. Moreover, an inset rotor structure was adopted to utilize reluctance torque, further enhancing the torque. The prototype inset permanent magnet (PM) motor successfully met the target torque and output power, achieving a maximum efficiency of 91%.
Next, to further improve efficiency, nanocrystalline soft magnetic materials, which have recently garnered significant attention, were applied to the motor core. Specifically, a motor stator was fabricated using a laminated core made of an Fe-based nanocrystalline soft magnetic material called NANOMET and integrated into the motor.
Fig. 1 shows the measured torque and efficiency characteristics of the prototype PM motor. It can be seen from the figure that a maximum efficiency of 95% was achieved while maintaining torque characteristics equivalent to those of a motor using conventional electromagnetic steel sheets (35A300).



(a) Torque (b) Efficiency

Fig. 1 Measured torque and efficiency of the prototype PM motor.