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Thu-Mo-Po4.03-10 [21]: Design and Analysis of a Novel Two-Dimensional High Frequency Magnetic Tester for Nanocrystalline Alloy Material

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Compared with other magnetic materials, nanocrystalline alloy has specific advantages. It can be made into strips that much thinner than silicon steel sheets and its conductivity is lower, which effectively reduces the high frequency loss. The permeability of nanocrystalline alloy is higher than that of ferrite, so the capacity and power density of the equipment made from nanocrystalline alloys can be larger at the same volume. In addition, the operating noise of nanocrystalline alloy is lower than that of amorphous alloy.
Nanocrystalline magnetic block cores can be used to make the high frequency electrical equipment, which exists T-joints structure. Due to the existence of magnetic flux leakage, the local two-dimensional (2-D) circular or elliptical magnetic field in the T-joints structure can cause rotational core loss. Therefore, it is necessary to study the 2-D high frequency rotational magnetic properties of nanocrystalline alloy materials.
This paper proposes a novel 2-D magnetic tester for nanocrystalline alloy material. The push-pull double-yoke vertical structure with square sheet specimen (28mm*28mm) is designed and fabricated to flexibly measure 1-D and 2-D magnetic properties up to 50 kHz. The magnetizer is made of nanocrystalline alloy sheet (0.02mm). Due to the high permeability of the material, the excitation current in the magnetization process is low and the excitation frequency can reach a higher level. The excitation effect of windings at different positions is simulated and compared. Considering the actual requirement, the 4-segment excitation winding on both sides of core is designed and every segment has ten-turn litz wire coil, which can be flexibly adjusted according to excitation frequency. A specific sensing structure with cross-shaped B needle method and double H sensing coils is adopted to guarantee the 2-D magnetic signals detection and improve the experimental precision. The losses measured by the tester under 1-D alternating excitation is compared with the official data, which has good accuracy. The 2-D magnetic rotational properties and losses of nanocrystalline alloy square sheet specimen are measured and analyzed.

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