

New Permanent Magnet Synchronous Motors with Amorphous Rolled Cores

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Amorphous metals are non-crystal alloy characterized by extremely low losses, high magnetic permeability and high fracture toughness. The disordered atomic structure of amorphous metals leads to low hysteresis loss and electrical resistance 3 times higher than that of steel sheet. The high resistance helps minimize eddy current losses when the metal is subjected to an alternating magnetic field. Compared to magnetic steel sheet, amorphous metals can reduce iron losses by at least one order digit. However, some problems have the potential to make amorphous metals inapplicable to motors. Amorphous metals have 5 times the tensile strength of steel sheet but they are also brittle which makes them difficult to stamp or cut.

In order to fabricate amorphous cores with less complicated process, we propose amorphous rolled cores without being machined. The cores are formed by many thin layers of amorphous metals and the lamination direction is perpendicular to the field of rotor that takes into consideration both the magnetic properties and iron losses. Axial gap construction is employed in the motor due to their compact shape and higher torque density. In references [1] and [2], several ways were proposed to construct amorphous motors with axial gap construction. However, these motors required complicated process and neither of them could guarantee the efficiency of motors. We designed and tested a high efficiency amorphous metal motor with simpler structure. The structure of motor with amorphous rolled cores is shown in fig.1. The amorphous core is shown in fig.2.

In this paper, the magnetic prosperities and iron losses of amorphous cores, design, structure and test results of the trial motor are introduced.

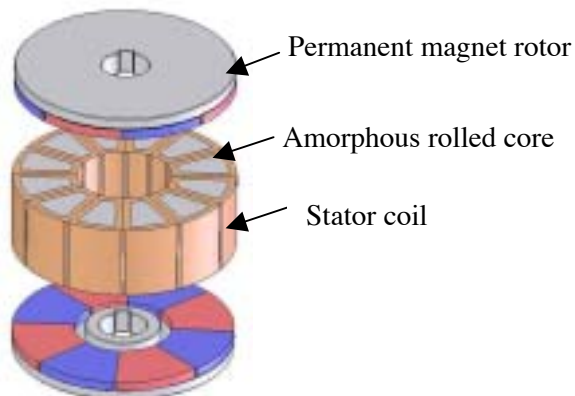


Figure 1: The structure of motor with amorphous cores



Figure 2: Amorphous rolled core

[1] US Patent 5986378 - Electric motor and generator having amorphous core pieces being individually accommodated in a dielectric housing.

[2] Rybak et al, USA Patent 6,106,376, "Bulk Metallic Glass Motor and Transformer Parts and Method of Manufacture", August 22, 2000.