APP3-1

Effectiveness of Filter Inductor of Rectifier Transformer Flux Pump in Energizing Multi-Stacked No-Insulation REBCO Pancake Coils

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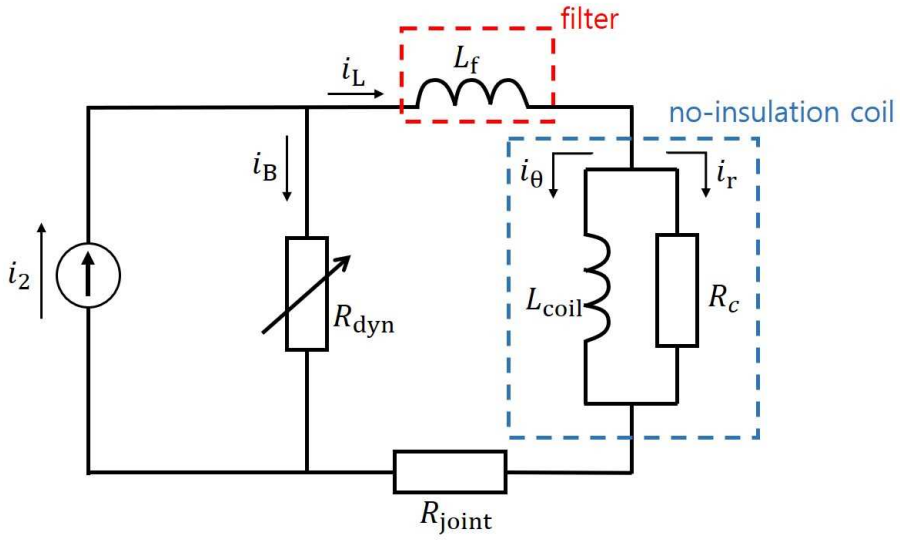
In recent years, strong field high-temperature superconducting (HTS) magnets are required in many applications, such as magnetic resonance imaging (MRI), nuclear magnetic resonance (NMR), particle accelerators, and so on. Also, they are applicable to rotors of highly efficient motors. For such applications, one attractive magnet-energizing method is a flux pump. A flux pump effectively increases a current flowing in closed loop made of superconducting wires without a large amount of heat penetration. When a current reaches to an arbitrary value, it is easy to switch to a persistent current mode (PCM), which needs no more power to retain the current. Recently it was reported that a flux pump of rectifier transformer type [1] could energize a REBCO magnet with no-insulation (NI) winding technique. Figure 1 shows the equivalent circuit model of rectifier transformer type flux pump (RTTFP) to energize a single NI REBCO pancake coil [1]. The variable resistance R_{dyn} works as a superconducting switch by the resistance change between the superconducting and normal state. The current increases when the switch turns off, otherwise the current is remained. The RTTFP performance was validated in experiments [1]. It was also reported that a filtering inductance improved the charging performance of a single NI REBCO pancake coil. That is, the amount of charged current increases and the charging speed is accelerated by using the filter inductor.

As a next development step, a practical application must be considered. Toward a practical application, some NI REBCO pancake coil must be stacked to generate a high magnetic field, however the stacked NI pancake coil has a large inductance. Therefore, the effectiveness of a filter inductor for multi-stacked NI pancake coils with a large inductance must be investigated further. We have extended the equivalent circuit model of Fig. 1 to multi-stacked NI REBCO pancake coils by connecting the equivalent circuit of NI pancake coils in series. We will check what is the best inductance for multi-stacked NI pancake coils by numerical simulation. The effectiveness of filter inductor will also be discussed.

[1] J. Ma, et al., “Charging performance improvement of flux pumping for HTS no-insulated coil,” Appl. Supercond. Conf., 2018.



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