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Simulation of Screening Current Reduction Effect of External AC Magnetic Field on Multi-turn REBCO Pancake Coils

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Screening currents induced in superconducting wires are well known as a critical issue upon NMR/MRI magnet operations. It invokes an irregular field and downgrades the magnetic field homogeneity of NMR/MRI magnets. Especially, in REBCO magnets, screening currents have a strong effect on an on-axis magnetic field due to the shape of REBCO tapes. Therefore, in order to reduce the screening current-induced magnetic field, Kajikawa et al. proposed a method of applying an external AC magnetic field in parallel to the REBCO tape's surface. The reason why the screening currents induced in REBCO coils have such considerable effect is that both positive and negative screening currents are separately distributed on the short edges of REBCO tape having more than 1000 aspect ratio. Then, by applying an external AC magnetic field, bosh the currents are separately re-distributed along the long tape edges. As a result, the screening current-induced magnetic field is decreased. A validity of this shaking field method was presented in experiments and numerical simulations. In the previous papers, we have presented the simulated shaking field effect on a single-turn REBCO tape. However, when multi turns of REBCO coils have to be considered, the identical magnetic field is not necessarily applied to all the turns due to their mutual interaction. In addition, their behaviors depend on the frequency and magnitude of AC magnetic field. Therefore, it is difficult to know the most effective condition of AC magnetic field. In the extended paper, we will present current distributions on the cross sections of multi-turn REBCO coil computed by 2D finite element method when an external AC magnetic field is applied with various kinds of conditions. We will also discuss about the field homogeneity created by re-distributed currents after applied shaking field.

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