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A Data-Driven Approach for Modelling the Relationship between Fabrication Parameters and Critical Currents of REBCO Coated Conductors in a Real-Scale Pulsed Laser Deposition System

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With the progress of applications such as compact nuclear fusion reactors and power devices using high temperature superconducting wires, the need for REBCO coated conductors (CCs) is increasing, and manufacturing of the REBCO CCs is shifting to mass production stage. On the other hand, the combination of process parameters in the REBCO CC manufacturing is diversified, and it is still insufficient for full-scale mass-production and commercialization which guarantee wire performance, yield, reliability, and cost reduction, therefore the innovation of CC manufacturing technology becomes an urgent issue. In this study, a data-driven approach, which fuses our reel-type high throughput critical current (Ic) measurements and machine learning, is applied to a real-scale REBCO CC Pulsed Laser Deposition system, and the behavior of a complicated process dependence of Ic has been successfully modeled. Using the combinatorial sample in which the manufacturing condition was systematically changed, we have collected over 20,000 data points on the relationship between the manufacturing conditions and Ic. A deep neural network (DNN) model was trained based on these data in order to describe the relationship between fabrication parameters and Ic. We have demonstrated that the Ic of the CC can be predicted from the process parameters by using this trained DNN model. Behavior in the multilayer deposition of the REBCO layer, which is inevitable in the practical CC production, is also studied. This technique allows us to break away from the conventional trial-and-error approach, and to quickly find the optimum manufacturing condition of the REBCO CCs *in silico*.

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