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M1Po2B-04 [34]: The Effect of Reinforcement Substrate Alloy Selection On Mechanical Properties of REBCO Coated Conductor

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REBCO coated conductors are promising candidates for high field (>25 T) user magnets. However, as the demand for higher fields increase, so does the potential to overstrain the conductors being used. Coated conductor substrates, such as 310 stainless steel and the super-alloy Hastelloy C276, serve as the backbone for mechanical strength in these conductors. Both substrate alloys share similar properties when optimally processed into strips prior to manufacturing of the REBCO coated conductor. We find that with subsequent REBCO manufacturing processes the strength of the substrate changes, the magnitude of which depends on whether Hastelloy C276 or 310 stainless steel is used. In this study, we investigate the stress-strain variability found in coated conductors and how the manufacturing process affects the mechanical properties. The manufacturing step of concern is the short time that the substrate is exposed to high temperature (700 to 800 C) during the REBCO deposition process. To better relate manufacturing processes and mechanical properties, we subjected bare substrates to different heat treatments at 700, 750, and 800 C for 15 minutes each. With post heat-treatment room-temperature tensile tests, we found that the 310 stainless steel substrate was sensitive to the variations of time and temperature, exhibiting yield strength reductions of 20 to 50 % depending on the heat treatment. By contrast, Hastelloy C276 did not weaken and initially showed strengthening effects with exposure to the lower temperature heat treatments. Coated conductor manufactures may prefer 310 stainless steel as their substrate due to cost and availability, however, moving to Hastelloy C276 will offer better mechanical robustness and reproducibility of mechanical properties within their coated conductor.

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