



Strength Variability of Structural Steel Substrates Used in REBCO Tapes

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Introduction

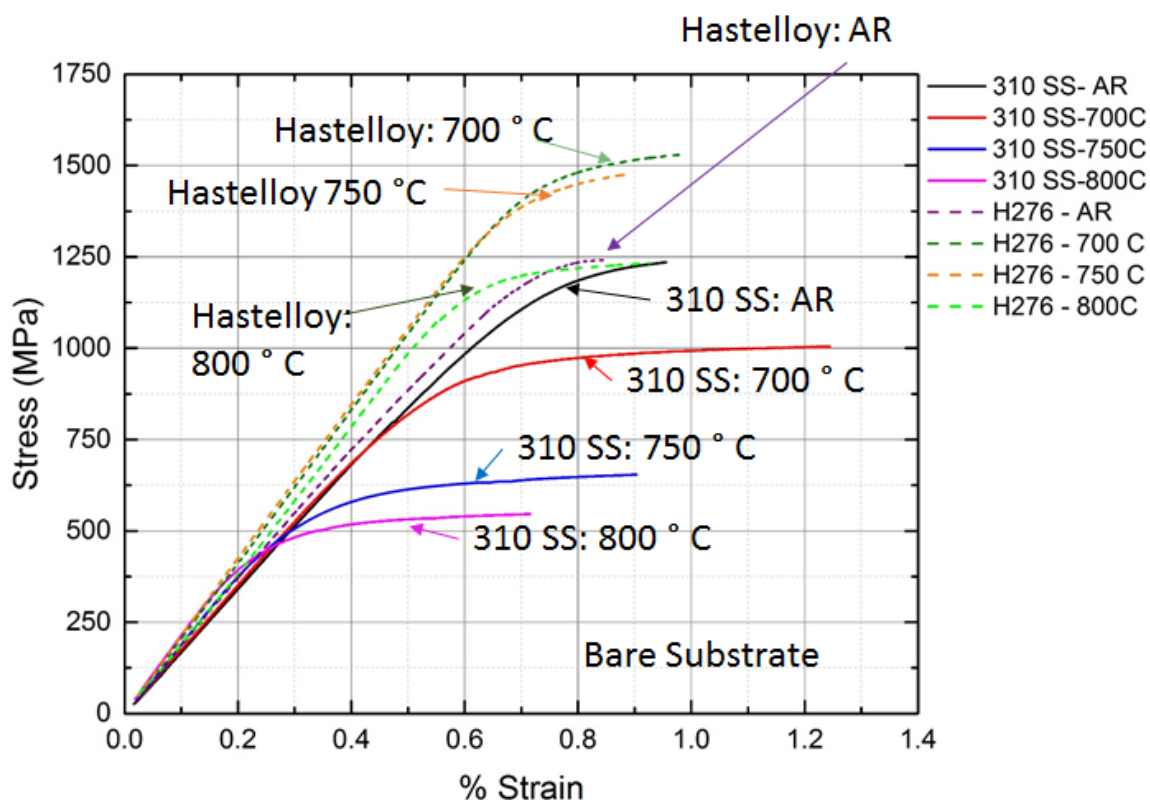
Austenitic steel is a commonly selected structural material used in superconducting magnet systems due to its strength and ductility at low temperature. Another attractive, readily available, but more expensive option for the REBCO substrate is Hastelloy C276 (a Ni-Cr-Mo alloy). Although these two materials have similar properties in the full hard condition, the in-service strength can be influenced by the HTS manufacturing route. Here we investigate the effect that processing temperature, due to the vapor deposition of the REBCO superconductor, plays on the properties of two substrate materials.

Experimental

The strengths of the thin tape substrate materials (4 mm wide x ~.1 mm thick) are evaluated by performing careful tensile tests according to the ASTM E8 test procedure. The baseline properties of the materials are measured on the as-received (AR) full-hard condition tapes. Since the vapor deposition processing time and temperature can vary, samples of materials are subjected to three different temperatures (700, 750, and 800 C) for short-time (15 min.) heat-treatments. Tensile tests are then performed on the heat treated tapes.

Results and Discussion

A graphical presentation for mechanical performance of these alloys is shown in the tensile stress-strain curves in Figure 1. Although the two materials are relatively comparable in the AR condition the heat treatments have a dramatic influence on the stress-strain behavior. The 700 and 750 C heat treatments improve the strength of Hastelloy while degrading the properties of the 310 SS. The 800 C temperature exposure appears to bring the Hastelloy back to its AR condition while it continues to degrade the 310. While there is a concerted effort to reduce the cost of REBCO conductors this research exposes a problem with using the lower cost 310 SS material.



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