

Mechanical and Superconducting Properties of Practical REBCO Wires

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Abstract - REBCO tape-shaped wires are now manufactured in the industrial scale. Practical REBCO wires are typical composite materials consisting of superconducting layer together with functional components of substrate, buffer, protection and stabilizer. Those functional components influence directly the mechanical and superconducting properties of the SC layer. It is therefore indispensable to analyze simultaneously their influence in both aspects of mechanical and superconducting performances. Key parameters on the thermo-mechanical property are the thermal strain exerted on the SC layer and the Young modulus of the composite which are deduced based on the rule of mixture.

Further the elasto-plastic behavior can be experimentally made clear. In the present report, four kinds of commercialized REBCO wires were examined. Their thermal strain, Young modulus and 0.2% yield strength together with the stress versus strain curves were determined and their sample dependence was numerically analyzed. The observed thermal strain and the Young modulus were pointed out to be consistent with the calculated ones. Stress / strain dependence of the critical current was investigated by means of two techniques using the tensile machine as well as the springboard. In general, the strain corresponding to the critical current maximum appeared in the reversible strain region. The reversible strain limit was defined as the 99% recovery of critical current. Both strains to the maximum and to the 99% recovery were experimentally determined and their correlation with the thermo-mechanical properties was discussed in terms of thermal strain and elasto-plastic behavior obtained from the analytical results mentioned above. The mechanical property and its influence to the critical current are very important performance in order to design the devices in practice. So it is requested to assess them quantitatively in the commonly acceptable manner. In this aspect, IEC TC90 provides international standards relating to the superconductivity technology. Above all, the recent progress on the assessment techniques of mechanical-superconducting performances of the REBCO wires is introduced and emphasized in order to promote them worldwide as the consensus based standards.

Keywords (Index Terms) – Coated conductors, tensile test methods, thermal strain, Youngs modulus, yield strength, standardization, electro-mechanical properties, critical currents.