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A multifunction test facility of cryogenic-electro-magneto- mechanical properties for superconducting wires/tapes under multi-fields

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A prototype of multifunction test facility for providing cryogenic-electro- magneto-mechanical multi-fields to investigate the field-dependence properties of superconducting wires/tapes is recently constructed in our laboratory. The apparatus is self-designed with several relatively independent sub-systems. A superconducting racetrack magnet made of NbTi/Cu is used to generate a background field along transverse direction (0-3.5T) in a relative large space of homogeneous region. A sub-system of cryogenic and vacuum Dewar vessel with a visible widow directly cooled by commercial Gifford-McMahon cryocoolers is manufactured to provide the operating cryogenic environment for the SC magnet and wires/tapes. For the purpose of efficiently and independently cooling the magnet and superconducting specimens, two GM cryocoolers are equipped in which one is for cooling the magnet at operation low temperature 3-5K, another supplies the cryogenic condition for the SC wires/tapes by conduction cooling mode. Additionally, to produce continuous variation temperature for the specimens an integration differentiation temperature control with an optional temperature sweep rate is utilized. The high DC supply to the superconducting wires/tapes with the maximum value of 1000 A is implemented by designing a kind of commercial superconducting lead composed of YBa2Cu3O7-x coated conductor and beryllium copper alloy. The sub-system of mechanical loading and measuring the specimens of SC wires/tapes is reconstructed by an electronic universal testing machine with widening and heightening design. Beside of recording the signals of electric, magnetic and temperature fields by means of contact measurement techniques with kinds of sensors, a contactless DIC method with a high speed/high resolution CCD camera is employed for the specimens of SC wires/tapes deformation and configuration measurements. Our preliminary experiment results show that the most functions of the multi-fields and the properties and responses of LTS/HTS wires/tapes as a function of magnetic field, cryogenic temperature, transport current, and deformation can be achieved successfully.

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