Introduction

High temperature superconductors are approaching widespread use in power transmission devices, and promise substantial improvements over current systems, both economically and technologically. However, performance of manufactured HTS products can vary greatly, and more research and characterization is still needed. One identifying feature of a modern YBCuO superconductor is the lamination strength between layers in the material, and a reliable method of accurately determining the adhesive strength of samples is required. This project focused on developing a Stud Pull Adhesion tester to determine this adhesive strength on second generation (2G) HTS samples from Superpower, Inc.

Materials and Methods

A prototype adhesion tester which was built at NIST was used as a starting point from which to refine the design and adapt it for local use. The entire existing design was put into SolidWorks, and extensive modifications were made, along with newly designed parts. Then, finite element software was used to analyze the strength of each design component, and any necessary changes were implemented. Final engineering drawings of the full set of parts (containing around a dozen pieces in three assemblies) were produced, and the part was slotted for production in the Union machine shop.

Results

COMSOS Works finite element modeling showed that none of the steel pieces of the device would fail under a 600 pound load, which is more than twice as high as the typical failure load for the initial NIST data. In addition, a more detailed investigation of the interface between the sample, the anvils, and the adhesives used to connect them was performed using COSMOS. This analysis indicated that purely transverse loads would not cause stress concentrations across the surface of the sample.

Final Design Features

- Designed for loads up to 600 pounds, corresponding to stresses up to 65 MPa
- Adapted to fit into the load frame in Professor Bucinell’s lab
- Two options for securing lower anvil: plate or universal joint
- Anvils made of Hastelloy C276, remainder made of AISI 8630 alloy steel

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