



Applied superconductivity for the electric grid

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Objective – This paper discusses the application of high temperature superconducting (HTS) devices in the electric grid. It first introduces the commercial HTS materials commonly used for grid applications. Then, three superconducting devices are discussed: the HTS cable to transmit high power at low voltage, the superconducting fault current limiter (SFCL) used in AC and DC power systems to limit fault currents, and the superconducting magnetic energy storage (SMES) to store energy. Some current projects, particularly in France, are presented.

Keywords – High temperature superconductor, electric grid, HTS cable, Superconducting fault current limiter, Superconducting magnetic energy storage.

1. Introduction

In this short paper, the two main types of HTS materials used for power system applications are introduced. Then, three HTS devices for the electric grid that are at the early stage of commercialization are presented: the HTS power cable, the Superconducting Fault Current Limiter (SFCL) and the Superconducting Magnetic Energy Storage (SMES).

2. HTS materials for the electric grid

There are two main types of HTS materials used for power system applications: BSCCO and REBCO [1]. They come either in bulk or in tape form. In this article, we focus only on HTS tapes because they form the basis of coils and cables. BSCCO and REBCO HTS tapes have different architectures: BSCCO tapes consist of BiSeCuCuO filaments embedded in a silver matrix, while REBCO tapes consist of different layers including a micrometer thick REBaCuO layer (RE for Rare earth). They can both be used at 77 K, the temperature of liquid nitrogen (LN2), which has the particularity of being an electrical insulator.



Figure 1 - Left: BSCCO tapes from Sumitomo, Japan. Middle: REBCO tape from Fujikura, Japan. Right: REBCO tapes from SuperOx, Russia.

3. HTS devices for the electric grid

The HTS power cable is a popular application of HTS materials for power systems. This is illustrated by various projects around the world [2,3]: LIPA, Annapcity, COMED, Superlink, etc. A French project named SuperRail between

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