The three superconducting global networks or the era of natural energy sources

Koichi Kitazawa

The manufacturing technology of the high temperature superconducting (HTS) materials has recently reached to a milestone high level so that we can safely predict the promising future of their applications. The critical current of HTS wire attained the target-set value of 100 Amps per wire of cross section 4 x 0.2 mm in 2005, and then the record value has reached 250 A by now.

The target value was set at 100A because then a superconducting instrument such as motor was expected to become smaller than when using normal copper wire. Also, the electric power cable can be made smaller in the cross sectional diameter with HTS material than the conventional cable. The overhead cable system like in Figure 1 can then be replaced by an underground superconducting cable system as shown in Fig.2.

In the US, in Albany N.Y., a superconducting cable as shown in Figure 3 has been being demonstrated in a real electric power line system so far successfully. The reason the superconducting power cable has been used is because an intensified electric power can be transmitted through the same underground cave channel.

The cooling technology has also been improved and tested. It is now becoming possible to cool a HTS cable with setting a nitrogen liquefier at ca. 20 km interval. The energy needed for cooling is below 0.01% of the power transmitted.

I will propose the three superconducting global networks for the sustainable society to come.

Superconducting MAGLEV train network: The first is the maglev train, utilizing the high HTS superconducting magnets installed on the cars. The superior safety and the readier maintenance are the expected advantages in addition to the limitless speed and the zero emission of exhaust gases. The HTS coil is favored for the higher safety. The maglev train system can avoid the energy consuming aircraft system.

Global superconducting electric power cable network: The second is the global superconducting electric power cable network system. The system will cover up the disadvantages of the natural energy sources such as solar power and wind power which are both subjected to intermittent power generation. The superconducting global cable can average the randomly intermittent power fluctuation created by each natural energy source, thereby facilitating the cost effectiveness of the natural energy sources significantly.

Perfect zero resistance of the superconducting cable enables us to transmit electricity even from the opposite side of the earth. This in turn will make it possible to average electricity for day and night on the earth. Additionally it is sometimes better to generate electricity on a remote site because of stronger/longer sun shine and wind. The advantage that the superconducting cable system allows complete electrical shielding should be favored by many because then the cable can be placed underground to avoid the sight pollution by the overhead cables.

Superconducting global communication network: Thirdly I will mention the possible development of the SFQ device for the telecommunication global network. The SFQ device is the only proven device to have achieved the significantly higher speed and the lower power consumption than c-MOS semiconductor devices. In order to safely promote the information revolution without facing the crisis of the electric power consumption, it is highly desired that the power consumption of the devices should be operated at lower power by more than two orders of magnitude.

The economics side of the three superconducting global networks will also be discussed.