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SOME TOPICS OF THE STANDARDIZATION IN THE SUPERCONDUCTIVITY

ABSTRACT *The standarizing activity in the field of superconductivity is presented. The purposes and an importance of this procedure both for material science as well as for technical applications of the low and high temperature superconductors is considered. The works of the IEC Technical Committee TC 90 – Superconductivity are described, with emphasizing the presently prepared standards in the subject of superconductivity. These standards concern both low temperature and high temperature superconducting materials in the form of bulk materials, wires and films as well as general parts being the vocabulary of the terms used in the superconductivity. The program of the standarizing works in the field of superconductivity is also discussed.*

1. INTRODUCTION

It is generally strongly believed that the superconductivity should be one of the most promising phenomena from the point of view of the future electric engineering applications. Its actuality has increased rapidly greatly just now it is after the discovery of the high temperature superconductivity. While the applications of the classical low temperature materials has been strongly limited due to the financial reasons, in the case of the high temperature oxide superconductors this barrier is much lower. It appears already very succesful large

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projects related to the application of the superconductivity phenomenon in the medicine in the form of the magnetic imaging resonance MRI, in the magnetically levitated train (MAGLEV), magnetic separation, nuclear fusion reactors (tokamaks and ITER program), energy storage (SMES), supercolliders for the nuclear physics investigations (LHC program), power transmission cables, fault current limiters, electronic sensors as SQUIDS and much other devices. It is expected that in nearest twenty years most of the power cables will be built just from the high temperature superconducting materials. The most of the presented programs is performed in the frame of the international cooperation, what is one of the reasons suggesting the creation of the standardization procedure on the matter. The necessity of using constructed devices in the various countries requires to fill by them standardizing procedures. The description of this problems is just the subject of the present paper.

2. PRESENT ACTIVITIES

The Standardization Committee TC 90 of the International Electrotechnical Commission IEC was founded in July 1989 at the aim of performing the standardizing works in the field of superconductivity. The chairman of the Committee is from the begin the scientist from USA, while Japan assumed the function of the secretary of the Technical Committee TC 90. The structure of the Technical Committee TC 90 superconductivity is based on the cooperation with the national committees, which presently are established in the 11 countries. These are in the alphabetic order: China, France, Germany, Great Britain, Italy, Japan, Poland, Roman, Russia, South Korea, USA. In fact the real work of the National Committees and Technical Committees is based on the Working Groups activity. In the case of TC 90, there exist at the present time moment eight Working Groups:

- WG1 considers the subject of the Glossary in Superconductivity.
- WG 2 is preparing the standard on the Critical Current Test Method for Cu/Nb-Ti wires.
- Critical Current Test Method for Oxide Superconductors is the subject of work of the Working Group 3.
- Residual Resistance Ratio Test Method for Cu/Nb-Ti wires is considered in the Working Group 4.
- WG5 is preparing the standard on the Room-Temperature Tensile Test Method for Cu/Nb-Ti wires.
- WG6 is occupied with investigations of the document on the Copper-to-Superconductor Ratio Test Method for Cu/Nb-Ti wires.

- WG7 is developed standardizing document entitled: Critical Current Test Method for Cu/Nb₃Sn wires.
- The last Working Group no 8 is occupied with the subject of the Surface Resistance Test Method for Superconducting Thin Films.

The standardization topics in the superconductivity are especially extensively developed in Japan, where three organizations cooperating with TC 90 exist. These are VAMAS (Versailles Project of Advanced Materials and Standards Technical), NMC (New Materials Center), JFCA (Japan Fine Ceramics Association) [1].

3. THE ACTIVITY OF THE POLISH NATIONAL COMMITTEE

The Polish National Committee cooperating with the Technical Committee TC 90 of the International Electrotechnical Commission IEC has the status of P-member. The P-member status means that this Committee is obliged to vote on the important documents and prepare appropriate opinions. The so called O-members are interested only in the receiving the circulating documents without the necessity of voting on them. The Polish Standardizing Committee working onto the superconductivity subject was created in the begin of 90-thies and has been subsequently organized as the individual commission, then was joined with semiconducting devices standardizing group, forming in this way the National Standardizing Committee no 66, while it has been recently included into the Special Technologies Committee no 290.

At the present time moment the standardizing procedure is concentrated on the material research. It means that this procedure is mainly focused on the superconducting wires. The Nb-Ti three component structure wires are considered as well as large capacity Nb-Ti buses and cables from this material. Other conventional low temperature superconducting materials which are the subject of the standardizing procedure are Nb-Sn and Nb-Al wires as well as the high temperature materials: Bi-based and Y-based. The standardizing procedure contains also the topic of the thin films materials in the aspect of using them in the microwave filters, commercial SQUID-s, digital circuits, antennas and in Josephson junctions as well. In these applications the standardization procedure will regard the methods of measurements the critical current, normal resistance R_n , noise level, surface resistance R_s for microwaves, clock frequency in electronic circuits, power consumption etc. In the case of wires, the most important points of standardizing procedures are focused to the following subjects:

standardization procedure of the critical current measurements, alternating current losses, volume ratio of matrix to superconductor, residual resistance ratio, tensile test in the room temperature, critical temperature, strain effect, AC quench current, pitch of twisting, AC sustainable current, critical magnetic field, filaments, stability test, composite structure, irreversible magnetic field. It is determined the time schedule of the realization this program taking into account the importance of above problems in the standardization procedure. The future task of the standardizing procedure is to apply it to the technical products built already with using superconducting elements. Additional and very important task of all standardization procedure is to harmonize the operating language in this field what is performed in the prepared vocabulary. The polish version of this vocabulary is just under preparation. Presently exists already few accepted International Standards. Standard of the number IEC60050-815 entitled Superconductivity Vocabulary, which is devoted to the terms and definitions is of the crucial importance. This vocabulary forms Chapter 815 of the International Electrotechnical Vocabulary IEC. Others five already established standards are as follows: Test Method for DC Critical Current of Nb-Ti Composite Superconductors (published in 1998 year) no IEC61788-1, DC Critical Current of Nb₃Sn Composite Superconductors (published in 1999 year) no IEC61788-2 as well as IEC61788-3 devoted to the Critical Current of Oxide Superconducting Wires, standard devoted to the Residual Resistance Ratio of Cu/Nb-Ti wires no IEC61788-4, Volume Ratio of Matrix to S.C. of these wires no IEC61788-5 and Tensile Test in Room Temperature of the Cu/Nb-Ti materials (IEC61788-6).

Above documents are issued as IEC standards but they are also accepted by CENELEC - European organization for standardization in electricity. It has especial importance from the point of view of our future incorporation of the European Union, which is partly related just with coordination of the existing standards in participating countries. Therefore, the International Standards should be prepared also in the form of Polish standards, what is main task of our standardizing committee. Presently beside the preparation of the opinions on the circulating documents our committee is preparing the polish version of the vocabulary devoted to the superconductivity, which should be in an accordance with the international document no IEC60050-815 being the Chapter 815 of the International Electrical Vocabulary IEC [2]. Few problems are appearing here connected mainly with the requirement of the agreement this Polish version with the international one, while taking into account some specific traditional differences in understanding the few items. It concerns for instance such item as the flux line, which is synonymous to the fluxon, while in Russian and also Polish nomenclature more popular synonymous to the flux line is fluxoid. In English version fluxoid has another meaning. The official languages of the IEC standards are English and French while the titles of sections are written addi-

tionally in others languages for instance German, Spain, Polish. The preparation of the standards is being the long term process, of the range few years, and is connected with circulation of the various documents of different level of promotion. It starts usually from Working Drafts WD up to Final Draft for International Standard FDIS, up to the International Standard IS.

REFERENCES

1. Report on Superconductivity International Standardization Vision, International Superconductivity Technology Center, March 1999.
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PEWNE ZAGADNIENIA NORMALIZACJI W NADPRZEWODNICTWIE

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STRESZCZENIE *W pracy przedstawiono działalność normalizacyjną w obszarze nadprzewodnictwa. Cele i znaczenie tej procedury zarówno dla badań materiałowych jak i dla technicznych zastosowań nisko- i wysokotemperaturowych nadprzewodników jest rozpatrywane. Prace Komitetu Technicznego Międzynarodowej Komisji Elektrotechnicznej TC 90 – Nadprzewodnictwo są opisane, ze szczególnym podkreśleniem przygotowanych ostatnio norm z zakresu nadprzewodnictwa. Normy te dotyczą zarówno nisko-temperaturowych jak i wysoko-temperaturowych materiałów w postaci litej, drutów i cienkich warstw, jak również ogólnych zagadnień, ujętych w słowniku haseł używanych w nadprzewodnictwie. Program prac normalizacyjnych w dziedzinie nadprzewodnictwa jest także dyskutowany.*