Projectnames: Development of technology for producing Bi-HTS superconductor ceramics with high critical parameters

Relevance: Currently, high-temperature superconductors (HTSCs) they are one of the most promising materials used in various fields of science and technology. HTSC the materials are widely used in such areas as energy, electronics, medicine, communications, and many others (electromagnetic screens, modulators, antennas, switches, and filtersUHF-and pulse signals, bolometers of the millimeter, submillimeter and infrared range of radiation, circuit diagrams of ultra-fast computers, sensitive medical tomographs and ultra-sensitive diagnostic devices that can respond even to changes in the mental state of a person, and many others) and the scope of application is expanding. Though, HTSCthe materials are already used in various fields, the problems of widespread use are limited with its cost, the complexity of the technological design and the values of critical parameters. In this regard, the development of an effective technology for producing ceramic materials with high current carrying capacity and critical temperature is an urgent task for practical application.

Purpose: Development of technology and optimization of Bi-HTSP ceramic production modes with high critical temperature and high critical current density.

Waiting and finish result: As a result of the research work carried out, a technology for producing high-temperature superconductor ceramics with a high critical temperature and an increased critical current density will be developed. We have developed a technique for obtaining initial amorphous materials from a melt with a high reactivity under the influence of IR radiation. On this basis, nano-dispersed powders were obtained by thermomechanical processing, and Bi-HTSC ceramics were synthesized . The kinetics of superconducting phase formation based on amorphous materials and nano-dispersed powders are studied. An increase in the rate of formation of superconducting phases up to 3-4 times in comparison with the solid-phase method has been established. Synthesis of Bi-HTSC ceramics with nano-dispersed inclusions of magnetic and refractory materials NiZnFeO, CoFeO, FeO, CuZnFeO effectively increases the critical current of superconductors.By studying the critical temperature, it has been determined that the temperature at which the transition to the SC state begins is in the range of 107-120K.

All tasks planned according to the calendar plan have been fully completed. The following publications were published for 2022.

Uskenbaev D., Zhetpisbaev K., Nogai A., Beissenov R., Zhetpisbaeva A., Baigisova K., Salmenov E., Nogai A., Turuntay S. Synthesis of High Temperature Superconducting Ceramics in the Bi(Pb)-Sr- Ca-Cu-O System Based on

Amorphous Precursors. Eastern-European Journal of Enterprise Technologies. 2022, №4/12 (118), P. 29-37. (Скопус, Процентиль 48).

Ускенбаев Д. Е., Ногай А. С., Ускенбаев А.Д., Жетписбаев К. У., Турмантай С. Балқымадан алынатын жоғары температуралы асқын өткізгіш қосылыстардың түзілуіне және қасиеттеріне жағдайлардың әсерін зерттеу. Вестник Торайгыров университета. Энергетическая серия. 2022, №3, С.186-199. (КОКСОН).

Ускенбаев Д.Е., Ибатаев Ж.А., Ногай А.А., Ускенбаев А.Д. Перспективы получения ВТСП керамики на основе висмута. Материалы Межд. научно-практ. конференции им. Д. И. Менделеева, посвяще. 90-летию профессора Р. З. Магарила. Том 2. Тюмень: ТИУ, 2022. С. 170-171.

Ускенбаев А.Д. Получение висмутовой высокотемпературной сверхпроводящей керамики из расплава и исследование свойств. Международная научно-практическая конференция. «Сейфуллинские чтения – 18: «Молодёжь и наука – взгляд в будущее». 2022, том I, часть VI., С. 41-44.

Ускенбаев Д.Е. Рентгеновские исследования висмутовых сверхпроводящих керамик, полученных из стеклофазы под воздействием ИК излучения. Международная научно-практическая конференция. «Сейфуллинские чтения – 18 (2): «Наука XXI века - эпоха трансформации» 2022, том I, часть VI., С. 273-276.

Сарсенбаева М.Б., Джусупова А.А., Ускенбаев Д.Е. Синтез и критические свойства висмутового высокотемпературного сверхпроводника составов 2234 и 2245. Международная научно-практическая конференция. «Сейфуллинские чтения – 18(2): «Наука XXI века - эпоха трансформации». 2022, том II, часть I., С. 162-164.

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Mendibayev S.A. - Candidate of Technical Sciences, Associate Professor, position in the project - Engineer.

Tursyntay S. - Master's student, position in the project-laboratory Assistant.

Information for potential users: Using the developed technology, it is possible to obtain massive HTSC ceramics with high current carrying capacity for wide applications. The technology can also be used to produce oxide materials for various purposes with special electrical properties – ferroelectrics, piezoelectrics, thermoelements, ferromagnets, solid electrolytes, etc.