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Enhancement of Critical Temperature and Improvement of Mechanical Properties of Yttrium Barium Copper Oxide Superconductor

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Abstract : Nowadays, increasing demand for electric energy makes applying high-temperature superconductors inevitable. However, the most important problem of the superconductors is their critical temperature, which necessitates using a cryogenic system for keeping these substances' temperatures lower than the critical level. Cryogenic systems used for this reason are not efficient enough, and keeping these large systems maintained is costly. Moreover, the low critical temperature of superconductors has delayed using them in electrical equipment. In this article, at first, characteristics of three superconductors, magnesium diboride (MgB2), yttrium barium copper oxide (YBCO), and iron-based superconductors (FeSC), have been analyzed and a new structure of YBCO superconductors is presented. Generally, YBCO (YBa2Cu7O2) has a weak mechanical structure. By introducing some changes in its configuration and adding one silver atom (Ag) to it, its mechanical characteristics improved significantly. Moreover, for each added atom, a star-form structure was introduced in which changing the location of Ag atom led to considerable changes in temperature. In this study, Ag has been added by applying two accurate methods named random and substitute ones. The results of both methods have been examined. It has been shown that adding Ag by applying the substitute method can improve the mechanical properties of the superconductor in addition to increasing its critical temperature. In the mentioned strategy (using the substitute method), the critical temperature of the superconductor was measured up to 99 Kelvin. This new structure is usable in designing superconductors' rings to be applied in superconducting magnetic energy storage (SMES). It can also lead to a reduction in the cryogenic system size, a decline in conductor wastes, and a decrease in costs of the whole system.

Keywords : critical temperature, cryogenic system, high-temperature superconductors, YBCO
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