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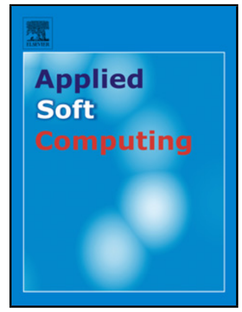

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Application of computational intelligence technique for estimating superconducting transition temperature of YBCO superconductors

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Abstract

Yttrium barium copper oxide (YBCO) is a high temperature superconductor with excellent potential for long distance power transmission applications as well as other applications involving generation of high magnetic field such as magnetic resonance imaging machines in hospitals. Among the uniqueness of this material is its perpetual current carrying ability without loss of energy. Practical applications of YBCO superconductor depend greatly on the value of the superconducting transition temperature (T_C) attained by YBCO superconductor upon doping with other external materials. The number of holes (i.e. doping) present in an atom of copper in CuO2 planes of YBCO superconductor controls its T_C. Movement of the apical oxygen along CuO2 planes due to doping gives insight to the way of determining the effect of doping on T_C using the bound related quantity (lattice parameter) that is easily measurable with reasonable high precision. This work employs excellent predictive and generalization ability of computational intelligence technique via support vector regression (SVR) to develop a computational intelligence-based model (CIM) that estimates the T_C of thirty-one different YBCO superconductors using lattice parameters as the descriptors. The estimated superconducting transition temperatures agree with the experimental values with high degree of accuracy. The developed CIM allows quick and accurate estimation of T_C of any fabricated YBCO superconductor without the need for any sophisticated equipment.

Keywords: Doped YBCO superconductors, support vector regression, superconducting transition temperature, and support vector regression computational intelligence based model and lattice parameters.

1. Introduction