CHEMICAL POTENTIAL OF A BINARY SYSTEM OF HELIUM ISOTOPES AT TEMPERATURES BETWEEN 0 K AND 5 K

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DECLARATION

This thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

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The undersigned certify that they have read and hereby recommend for acceptance of Masinde Muliro University of Science and Technology a thesis entitled "Chemical potential of a binary system of helium isotopes at temperatures between 0 K and 5 K."

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ABSTRACT

A study of the two stable isotopes of helium at low temperature was done using statistical mechanics approach. It was assumed that pairs of $^3_2He - ^4_2He$ were formed creating a new particle in the mixture. Such a mixture exhibits quantum effects at temperatures close to 0 K. A model of pair interaction was used. The partition function of the mixture was used in establishing the chemical potential of the mixture. The case of a particle in a cube of known volume was used. An expression of the chemical potential of the pair was obtained in terms of temperature. The relationship between chemical potential of the pair and temperature was studied. Also obtained is an expression of chemical potential in terms of density for a fixed volume of the mixture confined in a cubical container. A computer software mathCAD professional 2000 was used to generate data. The properties of the mixture over a wide range of densities and temperatures were analyzed. It was established that an increase in temperature led to decrease in chemical potential regardless of the number of particles in the system. The chemical potential of the pair in a mixture of fermions and bosons in the region of 0 K and 5 K is positive ranging from 8.972 x 10^{-6} eV to 4.4700 x 10^{-4} eV. The variatiation of chemical potential with temperature between 0 K and 5 K was $8.939 \times 10^{-3}\ eV/K$. The study also established that the chemical potential of the pair did not vary with change in quantum states.