Calculation the Hamaker Constant of Pb(Mg$_{1/3}$Nb$_{2/3}$)O$_3$ in Liquid Media

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1. Introduction

Investigation the interactions between the colloidal particles in liquid medium is crucial in many processes such as ceramic manufacturing. Total interaction potential between two identical bodies in a liquid medium can be calculated by the summation of the attractive van der Waals (vdw) and repulsive forces [1]. Van der Waals dispersive forces produce attractive interactions between bodies and play an important role in many material systems. The Hamaker constant is a quantity with which to represent these interactions between the particles [2]. It scales the London dispersion forces which is a part of vdw forces and it is a direct function of the optical properties of the interatomic bonds of the materials [3]. Lead magnesium niobate (PMN) is an important relaxor ferroelectric material and find applications in the manufacture of multilayer ceramic capacitors, actuators [4]. However, there is no a detailed study in literature on the Hamaker constant of this material in liquid medium which is a very important quantity in determination the colloidal interactions. It is aim of this paper to calculate the Hamaker constant representing the vdw interactions between PMN particles.

2. Materials and Method

Lead magnesium niobate, Pb(Mg$_{1/3}$Nb$_{2/3}$)O$_3$ powder which was produced by combustion spray pyrolysis method provided by Praxair Specialty Ceramics, USA. Powder purity is 99.9% as reported by the manufacturer. The Hamaker constant of PMN in water was calculated using Tabor Winterton approach and simple spectral method.

3. Results and Discussion

Figure 1 shows the retarded Hamaker function for PMN as a function of particle separation distance obtained by simple spectral method. The non-retarded Hamaker constant of PMN/water system is calculated to be $\approx 24.154 \times 10^{-20}$ J using the Tabor Winterton equation.

![Figure 1. Retarded Hamaker function of PMN as a function of separation distance.](image)

References