Writing a Mathematical Model for Bubble Formation

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Laser isotope breakdown spectroscopy is a type of atomic emission spectroscopy utilizing a high intensity laser pulse for plasma formation. The emission spectra can be used to determine the elemental makeup of the plasma. When used underwater, the plasma is formed inside a bubble of hot vapor. If the bubble is too small, the emission will be minimized as the plasma is quenched at the surface. The purpose is to develop a mathematical model which describes the formation of laser induced bubbles. The hypothesis is that changing the absorption coefficient (through changing the wavelength) will directly affect the size of the bubbles. A low absorption will generate a relatively small bubble as much of the energy will be transmitted through the water. Too high of an absorption coefficient will cause the laser energy to be absorbed close to the window where the intensity may not be high enough to vaporize water. This project will attempt to develop a model that predicts the ideal absorption coefficient for maximum bubble formation. The model has been completed through Gaussian beam propagation with focusing and absorption. As indicated by the data, too high of an absorption coefficient results in decreased fluence at the focus as the energy is absorbed near the window. If the absorption is too little, insufficient energy will be deposited at the focus and the rest of the energy disperses. Although the model is not complete, it already demonstrates that a proper laser wavelength must be selected for proper absorption.

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