Development and Validation of a Laser Induced Breakdown Spectrometry Method for Cancer Detection and Characterization

M.Sc. Research Proposal
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LIBS?

Laser Induced Breakdown Spectroscopy (LIBS) is a type of atomic emission spectroscopy which employs a highly energetic laser pulse to simultaneously prepare the sample and excite the species.

The qualitative analysis of emission spectrum provides the “fingerprint” of sample with regard to its elemental composition.
LIBS Technique

Main components of a typical LIBS apparatus
Calibration technique for LIBS

The simplest calibration technique is based on the use of standard calibration curves.

It consists in plotting interest intensity line as a function of known concentration from a set of calibration standards.

Ideally, there will be a linear relationship between the element response and the mass or concentration over the entire range investigated and a linear fit to the data should pass through the origin.

However

Calibration curves with the composition as close as possible to unkown samples are not feasible for most of the interest samples.
Moreover

The phenomenon of self-absorption may be considered as a factor of linearity deviation in conventional calibration. This phenomenon is a consequence of loss of signal at high analite concentration.

For this reason, linear models can be most of the time unsatisfactory.

Then comes the chemometrics!
Chemometrics has the ability to extract underlying phenomena from complex data with the help of multivariate techniques such as SIMCA, ICA, PCA, SVM and ANNs.

The information obtained is used to model and make accurate predictions about the unknown samples.

The techniques are also capable of capturing information about correlated trends in a given dataset.
Kew et al. reported that in normal liver the zinc concentration is about 78ug/g, wet weight and the primary liver cancer itself is about 18ug/g

It has also been reported that cancerous lung and breast tissue have higher zinc concentration than does normal tissue (Mulay et al.)

Higher concentration of copper have also been found in cancerous tissue more than in normal laryngeal tissue. In cervical cancer and in bladder cancer the elevations of copper concentration are related to the stage of the disease and decrease in response to treatment (Morton at al.)
Materials and Methodology

**Known Samples**
- Acquire LIBS spectra
- Use PCA to classify the known tissues
- Develop a Calibration model using ANN
- Use PCA to classify the known tissues
- Acquire a library of LIBS spectra
- Simulate sample with known concentration of trace elements
- Prediction of unknown samples using the model