Surface-assisted LIBS approach for the plasma diagnostic of salt samples

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Salt is an important nutrient for the human body. According to a WHO report, a high intake of Sodium (Na) (>2 grams/day) and insufficient Potassium (K) intake (less than 3.5 grams/day) can cause high blood pressure and increase the risk of heart disease and stroke. Owing to versatility of laser-induced breakdown spectroscopy (LIBS), this research work attempts to investigate constituent elements present in different types of edible salts and to study plasma parameters using surface-assisted LIBS approach.

In the first stage of the present work, different type of edible salts (e.g., iodised salt, rock salt, fortified salt, black salt, etc.) were pressed in the form of circular pellets (13 mm dia.) using a manual hydraulic press (75 kN). A high energy Nd:YAG laser beam (1064 nm, energy 6.4 mJ/pulse) has been focused on the surface of the salt pellets to generate a plasma. Emission from the plasma (for optimized gate delay and width of 1 μs) has shown strong self-absorbed resonant Na I spectral lines (588.9 nm, 589.5 nm), along with K I (766.5 nm, 769.9 nm), Ca II (393.3 nm, 396.8 nm), Mg I (285.3 nm), Mg II (279.5 nm, 280.2 nm), and other trace elements, which are insufficient for the estimation of precise plasma temperature from Boltzmann plot. To overcome this issue, salt solutions have been prepared and solidified forming a homogeneous layer on a Si substrate using special protocol. This methodology has been adopted from [1, 2], where liquid wine samples were transformed into solid. After optimizing the LIBS parameters, the obtained spectra from this surface provided a signature of Si spectral lines along with other major and trace constituent elements, allowing precise estimation of the plasma temperature and consequently, accurate elemental quantification. A comparative study based on the presence of these elements, and plasma parameters, among different samples, has been carried out.

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References:

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