A spectroscopic study for the characterization of high voltage composite insulators

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The efficient operation of composite insulators in overhead high voltage power transmission lines and sub-stations is of great importance for the transportation of electrical energy. However, their aging and the deposition of environmental pollutants on their surface can deteriorate their operational characteristics causing serious problems on the electrical power grid operation. In that view, the use of a laser-based technique, namely Laser Induced Breakdown Spectroscopy (LIBS), is used for the classification of insulators in terms of their aging and other processes affecting their performance. LIBS is an analytical technique employing a high intensity laser beam to induce a micro-plasma on the sample's surface. LIBS features a range of advantages over other spectroscopic methods, including rapid multi-elemental analysis, while being marginally destructive to the targeted material. Furthermore, LIBS is capable of remote, real-time operation without requiring the removal of the insulator from the power grid. Such advantages, make LIBS an interesting tool for the evaluation of composite insulators.

In the present work, different LIBS experimental configurations (single and double pulse LIBS) assisted by machine learning are applied for the classification of composite high voltage insulators based on their ageing, surface degradation and pollution due to environmental stresses, and chemical composition. The LIBS results are compared with other results obtained according to established protocols, including FTIR, SEM and EDX.

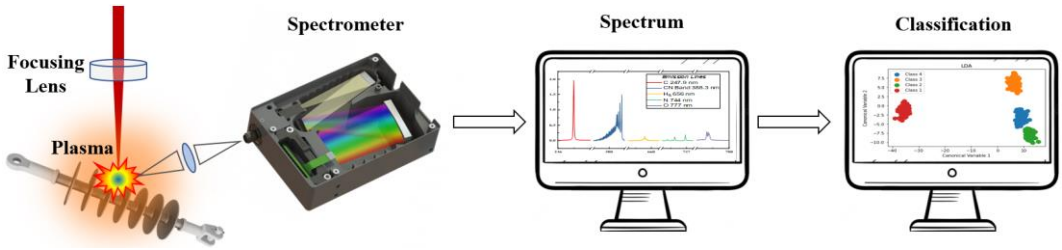

Figure 1: LIBS assisted by machine learning for the classification of high voltage insulators.

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