Toward acoustic detection of partial discharges in High Voltage cables.

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Partial discharge (PD) detection by acoustic methods has been commercially available for condition monitoring of overhead line insulators, insulation in power transformers, GIS installations or high voltage capacitors for quite some time. It has been generally regarded as impractical to implement for monitoring PDs in high voltage cables. This is probably the reason why acoustic signal signatures in insulation systems found typically in cables and cable accessories have not been investigated extensively, and as such, they are not very well known. Our recent work has established a good relationship between the size of insulation and the frequency of the acoustic signal emitted [1], [2]. In this context, an application of photonic techniques for the detection of acoustic signals has been also explored. The method employs fiber Bragg grating (FBG) written into optical fiber. An FBG-based device can detect wide spectrum of acoustic signals, which can be an advantage in comparison with piezoelectric transducers that are typically narrow-band. More importantly, optical fiber can be introduced easily into the cable and cable accessories to be near the potential source of partial discharges. Being a purely optical device, it does not require electrical connection to the sensor and it is immune to electromagnetic interference.

A generic FBG can be used in laboratory experiments but its sensitivity is not sufficient to be practical for on-line PD detection in cables. This work presents the development of an optoacoustic PD detector with the sensitivity gain of 50-60 dB in comparison with a generic FBG. This was achieved by selecting appropriate material and geometry for housing the sensing part of the fiber. This article describes the process of design and test results of the improved photonic sensor for partial discharge detection that potentially could be used in high voltage cable systems.

[1] Czaszejko, T.; Sookun, J., "Acoustic emission from partial discharges in cable termination," *Electrical Insulating Materials (ISEIM), Proceedings of 2014 International Conference on* , vol., no., pp.42,45, 1-5 June 2014

[2] Czaszejko, T.; Sookun, J., "Acoustic emission from partial discharges in solid dielectrics," *Electrical Insulation Conference (EIC), 2014* , vol., no., pp.119,123, 8-11 June 2014.