# Applications of Liquid Crystals in Intelligent Insulation

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In order to provide a robust infrastructure for the transmission and distribution of electrical power, understanding and monitoring equipment ageing and failure is of paramount importance. Commonly, failure is associated with degradation of the dielectric material. As a result, a great deal of research and development focuses on understanding ageing of materials and designing methods for condition monitoring. Smart dielectrics are materials which contain a chemical group that produces a measurable response depending on local environmental changes. The introduction of a smart moiety into a chosen material is a potentially attractive means of continual condition monitoring as the system is passive (requiring no maintenance), provides a clear visual output indicative of the local environment, and could be applied to equipment as a coating or even make up part of the bulk dielectric.

It is important that any introduction of smart groups into the dielectric does not have any detrimental effect on the desirable electrical and mechanical properties of the bulk material. Initial work focussed on the introduction of fluorophores and chromophores into a model dielectric system. It was necessary both to optimise the active smart chemical as well as explore the best methods of dispersing into a host polymer matrix. Equipment which allowed the spectra of a material to be monitored in real-time whilst under electrical stress was assembled.[1]

Liquid crystals are currently the subject of investigation as they are widely known to exhibit dramatic changes which are electric field dependant. It is possible to encapsulate droplets of liquid crystal in a host polymer to form a "polymer dispersed liquid crystal" (PDLC). Such materials are manufactured into films which can then be used in a variety of applications. It is possible to rigorously control liquid crystal composition and material microstructure in order to produce PDLCs which "switch" between clear and opaque states depending on changes in the local electric field [2], therefore making PDLCs potentially attractive smart dielectrics.

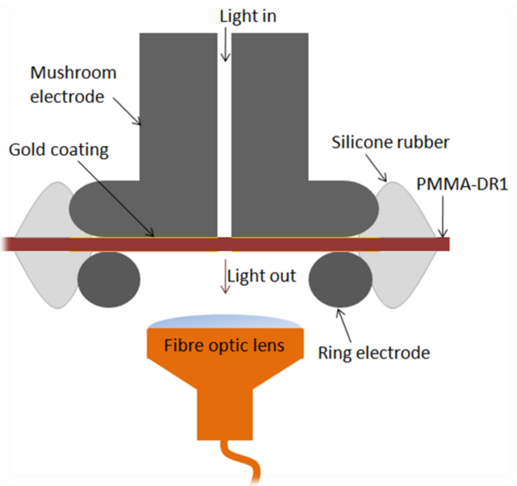


Figure 1: Electrode set up for monitoring spectra from a thin film of dye-doped polymer under real-time electrical stress.

[1] A. F. Holt, R. C. D. Brown, P. L. Lewin and A. S. Vaughan, "Fluorescent Probes as Electrical Field Indicators", *Electrical Insulation Conference*, 2011.

[2] N-H. Park, S-A Cho, J-Y Kim et. al., "Preparation of polymer-dispersed liquid crystal films containing a small amount of liquid crystalline polymer and their properties", *Journal of Applied Polymer Science*, vol. 77, no. 14 pp. 3178-3188, 2000.