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IDENTIFICATION OF LOW MOLECULAR MASS SPECIES ON THE SURFACE OF POLYDIMETHYLSILOXANE COMPOSITE INSULATORS BY MALDI-MS.

Susan M. Hunt, Birgitta Westerlund, Graeme A. George

Center for Instrumental and Developmental Chemistry, Queensland University of Technology, Brisbane, Australia.

The use of polymeric materials in the construction of insulators for high voltage power transmission has steadily increased over the past two decades. These polymer-based insulators provide advantages of being lightweight, having good damage and pollution resistance compared to more conventional glass or ceramic constructions. Furthermore, the low surface energy of virgin polymeric materials resist the formation of a continuous water layer which can cause insulator failure in wet conditions. Deposition of pollutants and the occurrence of electrical discharge, however, are known to reduce the hydrophobicity of polymer surfaces.

Insulators constructed from crosslinked polydimethylsiloxane (PDMS) have previously been found to regenerate their surface hydrophobicity during a recovery period after electrical discharges have occurred. Two mechanisms are thought to govern the recovery of hydrophobicity in PDMS insulators; one involving the migration of low molecular weight material (LMW) to the surface of the insulator to regenerate the silicone surface, the other by reorientation of the silicone backbone via molecular bond motion.[1]

To further investigate the mechanism of hydrophobicity recovery in PDMS via LMW migration, samples were collected from the surface of insulators which had been previously subjected to pollution and electrical discharge in service. Analysis of this surface material using matrix-assisted laser desorption ionisation (MALDI) mass spectrometry revealed high proportions of cyclic compared to linear PDMS species, particularly when compared to those present in low molecular weight silicone oils. The MALDI mass spectra of surface material were also compared to MALDI mass spectra of material extracted from the bulk of the insulator by a series of spercritical fluid extraction (SFE) experiments. The proportion of cyclic species observed in the extracted material was significantly lower than that found on the surface of the insulator. The proportions of cyclic species were also found to decrease with repeated extraction. These results support the hypothesis that cyclic species diffuse more readily to the surface of PDMS insulators than linear species and are likely to play an important role in the recovery of surface hydrophobicity via migration of LMW species.

[1] J.W. Chang and R.S. Gorur, *Proceedings of the 4th International Conference on Conduction and Breakdown in Solid Dielectrics*, Italy, 270-274 (1992)