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高电压技术

聚合物绝缘材料表面陷阱与电致发光现象研究

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摘要： 聚合物材料老化前会出现电致发光现象，其紫外分量可能导致材料的劣化。因此电致发光的研究可为分析材料老化和击穿机理提供依据。该文首先基于等温电流衰减理论，设计了材料表面陷阱参数测量装置，实验中采用多针电极对低密度聚乙烯(polyethylene，LDPE)、聚丙烯(polypropylene，PP)和聚四氟乙烯(polytetrafluoroetylene，PTFE)3种材料进行表面充电，记录表面电位衰减并按照等温电流衰减理论计算得到材料表面陷阱参数。结果显示，LDPE的陷阱密度较PTFE和PP大，LDPE和PTFE的电子空穴陷阱分布成对称结构，PP的电子陷阱密度明显大于空穴陷阱密度，这与材料的分子结构的对称性有密切关系。同时基于单光子计数模块设计了微弱发光数据采集系统，对上述材料在真空中交流电压下的电致发光特性进行了测量和分析。材料的陷阱密度对其电致发光特性具有重要的影响，材料的陷阱密度越高，发光越弱，反之则越强。

关键词： 聚合物绝缘 陷阱参数 电致发光 复合

Investigation on Surface Trapping and Electroluminescence Phenomena in Polymeric Insulation Materials

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Abstract: Electroluminescence (EL) usually occur before the aging of polymeric insulation materials, and EL has a component in the near ultraviolet (UV) region which is able to photodegrade the polymer, so EL technique can be used to investigate the electrical aging and breakdown mechanism of polymer. Based on the isothermal relaxation current (IRC) theory, a set of surface trap parameter measurement device for insulating materials was designed. The multi-needle electrodes were used to charge the surface of different materials such as the low density polyethylene (LDPE), polypropylene (PP) and polytetrafluoroetylene (PTFE) applied ±4 kV DC voltage, and the surface potential decay values were recorded in computer by the measurement system, finally the trapping parameters could be calculated according to the IRC method. Of the three kinds of material, the trap density of LDPE is higher than that of PTFE and PP. The distribution of electron and hole of LDPE and PTFE is symmetry, but the electron trap density is higher than hole trap density of PP, which is related to the molecular chain symmetry of polymer material. Moreover, based on a photon-counting module, a set of weak light measurement device was developed. The EL phenomena from the above polymers was studied under AC voltage application in vacuum. The experimental results reveal that trap density plays an important role on the EL characteristics, and higher the trap density, lower the light intensity.

Keywords: polymeric insulation trapping parameters electroluminescence recombination

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