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Reducing radiation-induced conductivity in polymeric dielectrics by small molecule electron traps ROBERT J. KLEIN, JOHN L. SCHROEDER, SHANNON M. LACY, MICHAEL E. BELCHER, PHILLIP J. COLE, JOSEPH L. LENHART, Sandia National Laboratories — Polymeric dielectrics, when exposed to ionizing radiation, undergo the formation of electron-hole pairs and consequently exhibit radiation-induced conductivity (RIC), severely limiting the insulating capability of polymeric dielectrics used in ionizing environments. RIC can be significantly reduced by the incorporation of small-molecule traps: in the appropriate concentration range, small molecules consisting of aromatic rings and strongly electron-withdrawing groups can reduce RIC by more than 95 % in poly(ethylene terephthalate) films. The dopant structure is critical: the addition of one nitro group, the strongest electron-withdrawing substituent, leads to $>$ 98 % RIC reduction when placed on fluorenone, pyrene, acenaphthene, and anthracene cores. Other substituents, such as cyano or amino, improve RIC reduction over the isolated cores, but not as effectively as the nitro group. The electron-withdrawing capability of each substituent side group can be quantified using the Hammett parameter.

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