Abstract：Cellular polypropylene (PP) films were fluorinated under a high pressure of 13 bar of the F_2/N_2 mixture and were post-treated by nitrous oxide and isothermal crystallization. The fluorinated and post-treated PP films after being expanded and corona charged exhibit a significantly improved piezoelectric thermal stability. After annealing at 70 °C for 151 h or at 90 °C for 224 h, the piezoelectric d_{33} value of the fluorinated and post-treated piezoelectric sample still retains 58% or 45% of its initial d_{33} value, while the corresponding value of the virgin piezoelectric sample has decreased to 29% or 15% of the initial value. Chemical composition analysis of the cross section of the fluorinated and post-treated film by energy-dispersive x-ray spectroscopy indicates that the internal layers have been fluorinated, in spite of a lower degree of fluorination compared with the fluorinated surface layer. Short-circuit and open-circuit TSD current measurements reveal that the fluorinated internal layers, like the fluorinated surface layer, also have very deep charge traps, although there probably is a difference in density of the deep traps between them. The deeply trapped charge on the internal layers of the fluorinated and post-treated piezoelectric sample is responsible for its significantly improved piezoelectric thermal stability.