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Application of Nuclear Reaction Analysis for the fluorine content measurements under the aging investigation of the gas-filled particle detectors.

Some time ago it was demonstrated that the method of Nuclear Reaction Analysis (NRA) is very effective for investigation of the aging effects in the gas-filled detectors operated under high accumulated dose. The most important plasmachemical reactions for the gas mixtures (Ar/CO2/CF4 and Xe/CO2/CF4) produce many different active species including oxygen and fluorine. For the detection and quantitative evaluation of the oxygen and carbon content as a function of depth in the gold, the following nuclear reactions with deuterons and protons in the energy range of 0.7-1.1MeV have been applied: 12C(d,p)13C and 16O(d,p)17O. Application of the NRA in our aging investigations gave us a reliable confirmation of the oxygen key role in the wire-swelling mechanism and demonstrated the kinetics of oxygen transport into the depth of the gold coating. Special interest for our gas mixtures are two chemical agents which determine possible gold etching: fluorine and xenon-fluorine XeFn(n=2,4,6) compounds. These agents are strong oxidizers and may interact with the gold, causing etching. So, in order to understand one of more important stages of the wire aging mechanism development, it was principally important to develop the NRA method for investigation of fluorine distribution in the anode wires. To investigate the fluorine content and depth profile in wire the nuclear reaction 19F(p, α) 16O has been used. The energy spectrum of the α-particles produced by the (p,α)-reaction has been measured. It was shown that sensitivity of proposed method is about 1×10 16 at/cm3. The fluorine concentration and their depth distributions have been measured for different gas mixtures under the total accumulated dose up to 1.8C/cm for each.

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