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Complex method of preparing working medium for two-phase xenon emission detector

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The attachment of electrons to electronegative impurities in condensed phases is the most important process limiting performance of two-phase emission detectors. These impurities are also responsible for some other processes that degrade the efficiency of the detector, such as reducing energy of electrons during drift and absorbing UV radiation. We present a complex method for preparing working medium for the next generation of two-phase emission detectors planned for use in the largest international nuclear physics experiments. The method is based on multi-stage technology for xenon purification from electronegative impurities. In the first stage, liquid xenon is irradiated by the hard ultraviolet radiation generated by an electric high-voltage discharge in a liquid, for the purpose of decomposition of complex high-molecular impurities due to photolysis. At the second stage, a massive sample of liquid xenon is purified with nanodispersed titanium generated in the liquid by a high-voltage electric discharge between the titanium electrodes. In the third stage, which can run parallel to the first and second stages in time, the internal surfaces of the detector and gas lines are cleaned by repeatedly circulating the gaseous xenon through a hot metal getter in a closed loop. At the fourth stage, already during the operation of the detector, the liquid xenon is withdrawed from the filled detector, evaporated in a special heat exchanger, goes through the hot metal getter, and condensates into the detector by means of a heat exchanger. This stage is carried out simultaneously with a physical experiment and assumes a continuous measurement of the lifetime of electrons before capture by electronegative impurities to correct the experimental data obtained.

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