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State-of-the-art surface coating for radon background mitigation

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For rare event searches using liquid xenon detectors, radon-induced background represents the most significant contribution. Specifically, 222-Rn, a decay product of 226-Ra found in all materials, enters the detector's active region by emanation from the material surfaces. To meet the sensitivity requirements for the next generation of detectors, this background must be reduced by about one order of magnitude compared to the levels achieved by the current generation (XENONnT 222-Rn activity ~ 1 µBq/kg). The current radon mitigation techniques might not be sufficient to reach this goal, necessitating the exploration of alternative strategies.

At the Max-Planck-Institut für Kernphysik (MPIK), various surface coating techniques have been intensely studied as radon barriers. Among them, the electrodeposition of pure copper has emerged as a promising mitigation method. We achieved a thousandfold reduction in 222-Rn emanation on a 2×2 cm² stainless steel sample previously irradiated with 226-Ra at the ISOLDE facility at CERN. Following this successful small-scale test, the setup was upgraded to allow larger, vessel-like samples to be coated. Additionally, new 226-Ra implanted samples have been produced to validate the reliability of the coating technique further. The current state of the coating project will be presented, along with a discussion of upcoming operations.

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