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Ultra-purification and mass-production of NaI powder for COSINE-200

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The COSINE-200, an upgraded phase of the COSINE-100 experiment, aims to scrutinizingly verify the annual modulation signals observed by the DAMA/LIBRA experiment using 200 kg NaI(Tl) crystals with intrinsic background levels better than those of DAMA/LIBRA. To reach the projected goal, an in-house technology for the successive production of ultra-low background NaI(Tl) detectors is paramount, and it must begin with procuring ultra-pure NaI powder. A special clean facility for purifying commercial NaI powder in bulk has been constructed at the Center for Underground Physics (CUP) in Korea. The purity of CUP-produced powders is compatible with those of Astro-grade available from Sigma-Aldrich and surpasses the purity of the NaI powder used in DAMA/LIBRA crystals. The production efficiency of 35 kg per two weeks has been balanced versus the optimum product's purity, where impurities levels are < 20 ppb for natK and <10 ppt for 232Th and 238U. This report summarizes our experience, describes the mass-purification facility and the technology itself, and finally the recovery of NaI from by-products of chemical purification and the melt that residues after the crystal growing performance.

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