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New technology for manufacturing scintillation elements for a highly segmented 3D neutrino detector

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To improve the sensitivity to CP violation, reduce systematic uncertainties, T2K launched an intensive upgrade program that includes the upgrade of the near neutrino detector ND280. A novel 3D highly granular scintillator detector, called SuperFGD, of a mass of about 2 tons will have the full polar angle coverage for charged particles produced in neutrino interaction, a low threshold for proton detection and a capability to measure neutrons using time-of-flight. It consists of about two million of small optically isolated polystyrene based plastic scintillator cubes with a 1 cm side. Each cube is read out in three orthogonal directions with wavelength shifting fibers inserted into three holes and coupled to compact photosensors, Micro Pixel Photon Counters (MPPC). The cubes for SuperFGD detector were made by injection molding, and the holes are drilled using a high-precision machine. The new technology for production of scintillation elements is to develop a press-form which makes cubes with 3 orthogonal holes. This will significantly improve the geometric parameters of the elements, such as the dimensions accuracy and the precision of the hole position, which is extremely important for assembly of a new SuperFGD type segmented detectors with a mass of a few tons. However, the use of such mold introduces a new challenge of coating the surface of the cubes by an optical reflector. The details of new technologies and test results of the first samples of scintillation elements will be presented.

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