

Fluidic Trapping Device for Electron Microscope Sample Preparation

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Pathologists use electron microscopy to screen patient intracellular and extracellular structures looking for signs of pathologies in cells. The preparation process of tissue samples for EM requires successive immersion of tissue specimens in a series of solutions for brief periods. Using traditional techniques, this preparation process would involve manual manipulations of the sub-millimeter tissue sample, placing the small tissue at risk for damage or loss. Here, we propose a fundamentally new approach for handling and processing small tissue specimens. Our setup involves a dual-syringe pump, two syringes connected to syringe tubes, two trapping patterns, and a heated rotator. We designed and 3D printed a plate and a rectangular rod with various sizes of trapping cubes to accommodate different sizes of tissues in the range from 400 μm to 880 μm . For deparaffinization (including rehydration and post-fixation) and dehydration, we first placed the tissue into the corresponding cube of the trapping plate, then utilized the syringe-pump system to alternate between withdrawing and infusing to continuously wash the trapped tissue with different solutions and time required for each process. Then, for infiltration, we transfer the tissue into the rectangular-rod-like trapping pattern and rotate them inside the 1.5 mL tube filled with 1:1 epoxy resin/acetone followed by 100% epoxy resin mixture for a total of five hours. The tissues will be ready for electron microscopy after polymerization in the oven at 60° overnight. By utilizing the new procedures for sub-millimeter tissue preparation, we achieved a small tissue loss rate (1/10) and maintained a similar image quality.

