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Automated, Programmable Processing of Specimens and Grids with the mPrep™ ASP-1000

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Electron microscopy (EM) specimen preparation and grid processing are tedious, time consuming and prone to error. For most life science applications and some materials applications, preparation for Transmission or Scanning EM requires each specimen to be sequentially processed with multiple fluids such as fixes, rinses, solvents, resins, stains, and labels. Similarly, TEM grids are fluid processed to stain sections, to deposit macromolecules and nanoparticles, for negative staining, and for immuno-labeling. In a typical life science TEM tissue preparation process there are 20-25 fluid exchanges for each specimen, and numerous grid fluid exchanges. Thus with several specimens and grids it is not uncommon for there to be well over 100 exchanges that can easily occupy most of a day. Yet, in most labs, these fluids are delivered manually due to reasons such as:

1. The number of samples does not warrant using automated sample immersion batch-type instruments,
2. Different specimens in the same study must be prepared with different reagents or protocols, and this can not be done using specimen immersion batch process instruments,
3. Reagents used are expensive and immersion batch processing requires several milliliters when only microliters are required for manual handling (such as for immuno-labeling tissues en bloc or grids),
4. The lab does not have an automated tissue processer, an automated grid stainer, and/or an automated immuno-labeling grid processor.

This presentation introduces the mPrep ASP-1000 (micro-Preparation Automatic Specimen Processor). This entirely new class of automated instrument uses mPrep/s™ capsules for specimens and mPrep/g™ capsules for grids (Fig 1). As with all use of mPrep capsules, manual handling is nearly eliminated. Specimens are only directly touched when they are placed into mPrep/s capsules (and oriented when desired), while grids are only touched when inserted into mPrep/g capsules and removed for imaging. Since all fluid processing and storage occurs in a labeled mPrep capsule, sample identity is assured.

The mPrep ASP-1000 incorporates intuitive programing to specify “Reagent, Time, Agitations, Repeats” for any desired number of steps (72 steps are available in the configuration shown). Capsules are simply mounted on the ASP pipette head (Fig 1) and reagents are placed in microtiter plates on the ASP tray. The selected program then sequentially delivers reagents by moving mPrep capsules to different microtiter well locations. Set-up and clean up are fast, and reagent consumption can be as low as 10 µl per specimen step (typically 100 – 150 µl), and 35 µl per mPrep/g step for 2 grids. Each capsule may receive the same or different reagents as other capsules, thereby enabling simultaneous processing of titrations and controls as needed for immuno-labeling and other complex protocols [1].

The ASP-1000 is the first automated instrument that processes both specimens and TEM grids, and can perform essentially any protocol with minimal reagent consumption. Figure 2 shows high quality preservation and staining of porcine heart and skin prepared with Karnovsky and OsO_4 fixation, acetone dehydration, epoxy embedding, and uranyl acetate and lead citrate grid staining. Laboratory efficiency is increased by enabling other tasks to be performed during computer-controlled, reproducible specimen and grid preparation. Process monitoring is intuitive with direct observation, while the ASP-1000

software also enables sophisticated remote monitoring including notifications of procedure completion and other events via web browser, email or text message. Since any fluid can be delivered to specimens or grids within mPrep capsules, with any agitation or timing, only imagination limits the processing applications of the mPrep ASP-1000.

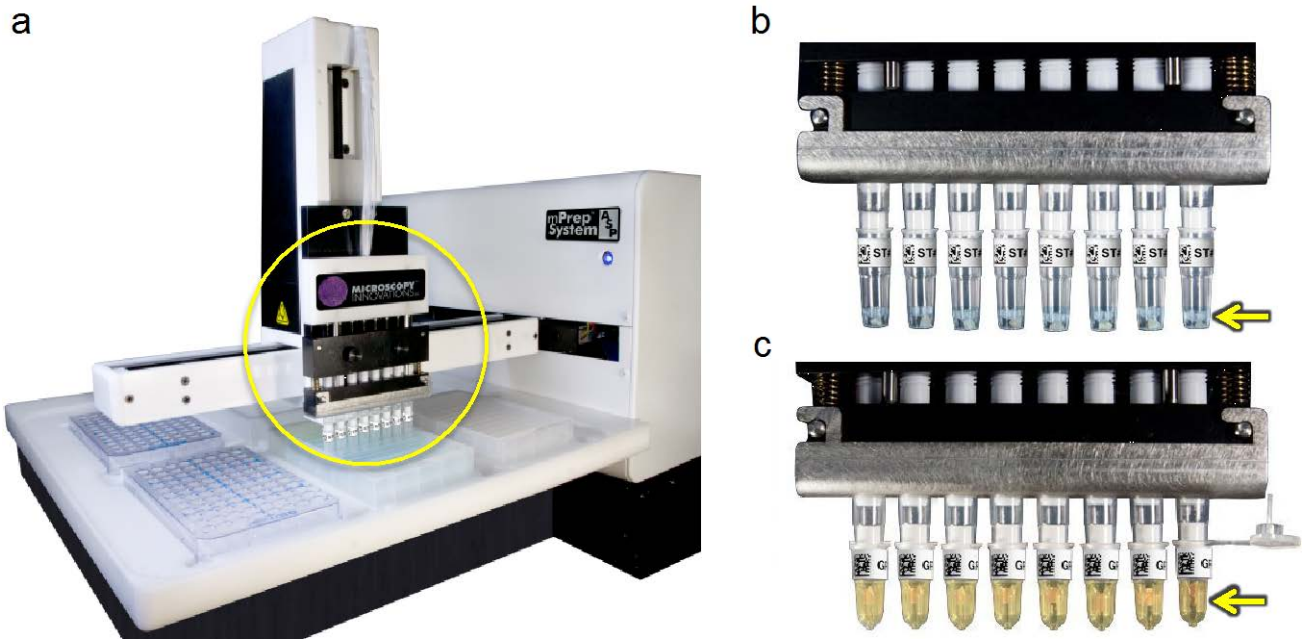

Fig 1: a) The mPrep ASP-1000 processes specimens or grids mounted on the computer controlled pipette "head" (circled) that moves them between reagents in microtiter plates on the processor tray.
b) Processor pipette head with 8 specimens entrapped in 8 labeled mPrep/s capsules (arrow points to one specimen). c) Head with 8 mPrep/g capsules containing 16 grids (arrow points to one grid).

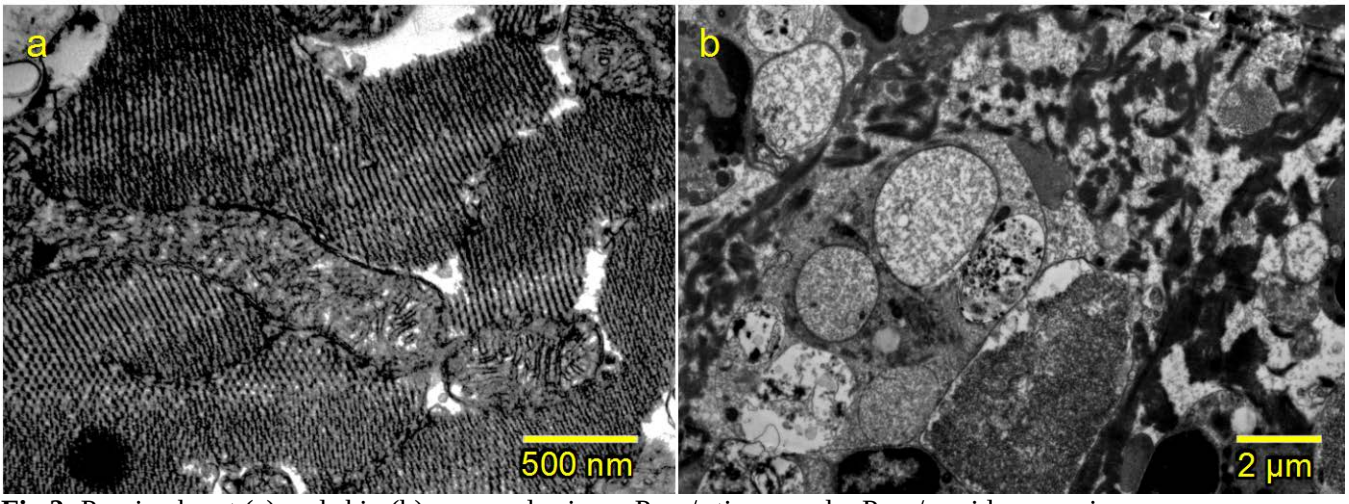

Fig 2: Porcine heart (a) and skin (b) prepared using mPrep/s tissue and mPrep/g grid processing.

Reference

[1] M McClain, High Throughput Multi Parameter TEM Chemical Processing Protocol Development with the mPrep-s Capsule System. *Microsc. Microanal*. 20 (Suppl 3) (2014) 1288-9.