The transmission dynode (tynode) vacuum electron multiplier

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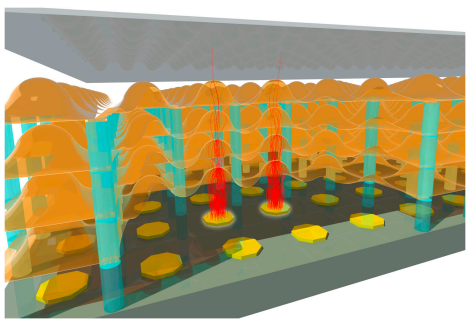
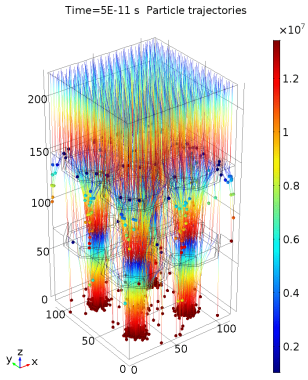


Figure 2.1: Schematic image of the basic working mechanism of Tipsy. The top grey plate represents the photo-cathode, the tynodes are orange plates (the shape is discussed later on) and the gold octagons are the anodes on which the electrons (red tracks) are collected. Image from [14], to get a sense of the dimensions: one column is 55 µm by 55 µm and the spacing between the plates is approximately ± 100 µm.



simulation of the timing of the electrons.

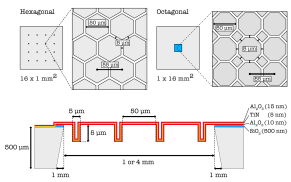
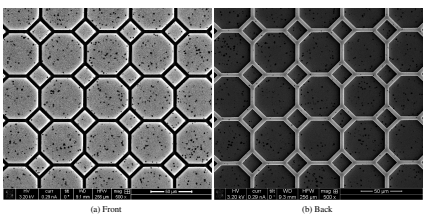
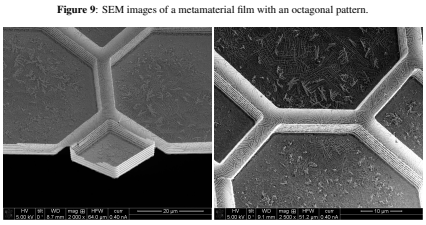


Figure 4: The corrugated membrane are suspended within a silicon frame with a dimension of 20 mm by 20 mm. For the hexagonal pattern, 16 square windows are opened in the silicon frame. Each corrugated membrane has an active area of $\sim 1\,mm^2$. For the octagonal pattern, the silicon frame has a single window in which a membrane with an active are of $\sim 16\,mm^2$ is suspended.



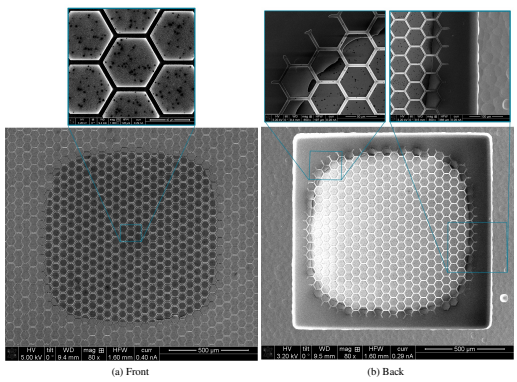
(a) Front (b) Back

Figure 9: SEM images of a metamaterial film with an octagonal pattern.



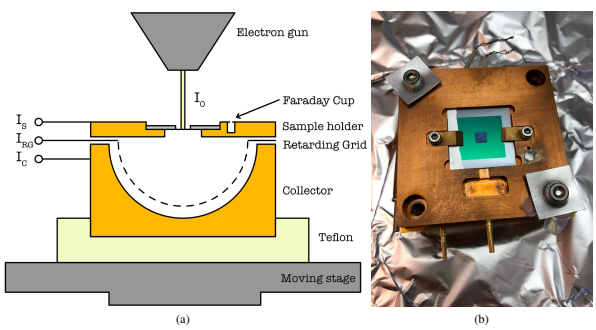
(a) (b)

Figure 10: SEM images of a broken metamaterial film with an octagonal pattern. The etch lines of the DRIE process is visible on the ribs. (a)



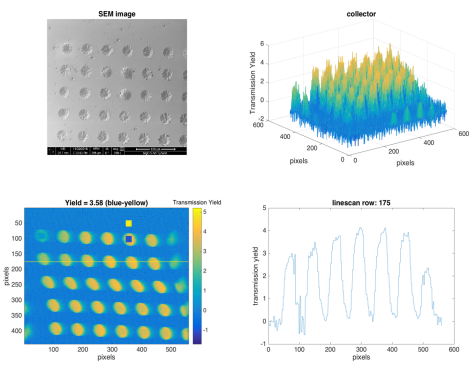
(a) Front (b) Back

Figure 7: SEM images of a metamaterial film with a hexagonal pattern. (a) The contrast between the active area and the window frame is due to the transparency of the film for 5 keV electrons. (b) On the backside, the ribs protrude outwards and appear brighter since SEs are generated closer towards the SE detector of the SEM. On the edge, the ribs disappear into the silicon substrate.



(a) (b)

Figure 6: Experimental setup. (a) schematic drawing of the collector. (b) The copper collector with one of the octagonal metamaterial membrane mounted in the sample holder.



The synchronized measurement of a SEM image and the transmission secondary electron yield (TSEY)

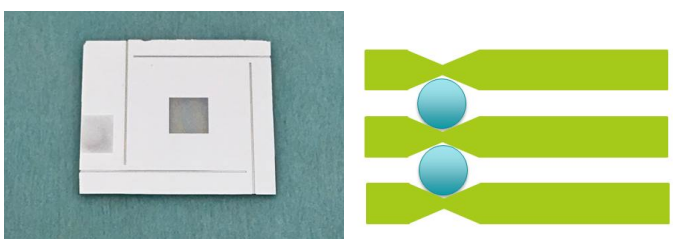


Figure 6.1: Left: picture of tynode (taken with phone camera, not the microscope). Tynode's provided at courtesy of Violeta Prodanovi [6]. Right: Schematic drawing of self alignment mechanism.

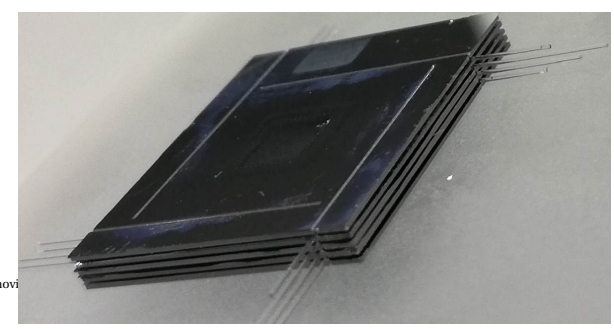


Figure 6.5: Final stack of 5 tynodes, picture taken with phone camera.

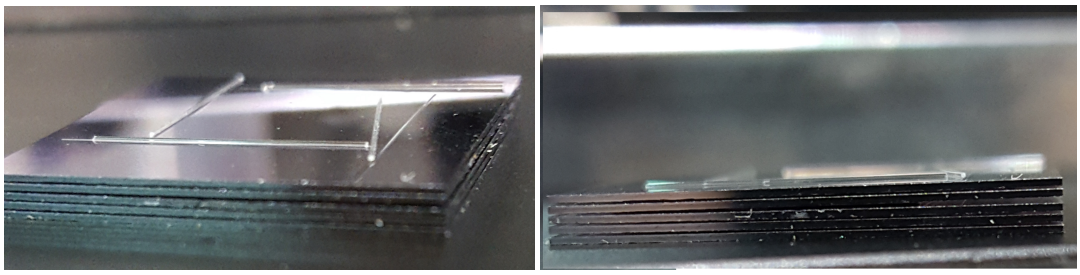


Figure 6.2: Left: dummy tynode stack with focussed on the grooves, right: dummy tynode stack focussed on the edge.