Microcapillary capsule for nanoscale and real time observation of materials in liquid by transmission electron microscopy

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Nanometer-scale resolution and real-time observation of materials in liquid environments is required for drug discovery, tissue engineering with induced pluripotent stem (iPS) cells, and synthesis of metallic nanoparticles [1–2]. Transmission electron microscopy (TEM) has the potential for such applications because it offers atomic-level resolution and adequate video rates. However, samples must be kept under ultra-high vacuum conditions,, which makes observation of aqueous solutions challenging. Here, we propose an innovative ‘wet-TEM capsule’ consisting of a sample container separated by nanometer thick membranes that enable an electron beam to be transmitted without liquid leaking when the capsule is inserted into a TEM vacuum chamber.

Fig. 1 is scanning electron microscope image and a schematic of our wet-TEM capsule, which consists of external tubes, silicon support substrate, window region, and silicon nitride membranes. First the silicon support silicon substrate with nanometer silicon nitride membranes was etched to create window regions. Subsequently, capillary tubes were integrated in between two chips. The gap between the membranes contains the sample solution that is injected via the external tubes. We will describe recent experimental results on the observation of magnetic nanoparticles using the wet-TEM capsule system.

Reference
1) Niels de Jonge and Frances M. Ross: Nat. Nanotechnol., 6, 11, 695 (2011)
2) S. Zhang, et. al.; Open Surf. Sci. J., 4, 26 (2012)

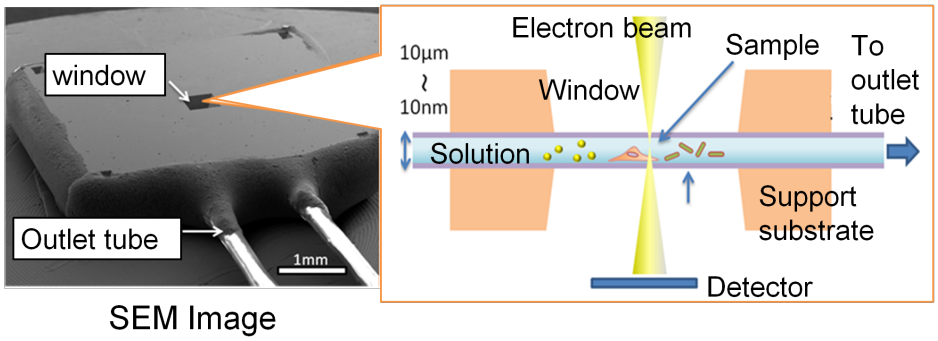

Fig.1 SEM and a schematic image of our capsule