

Aqua Cover Technique for Direct Observation of Water Containing Specimens

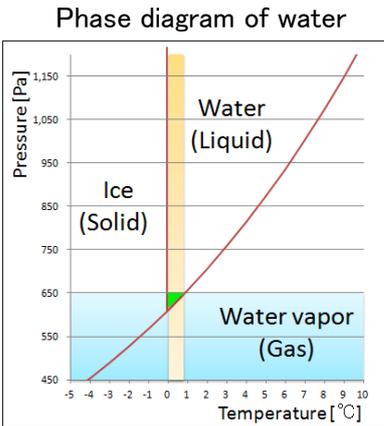
Direct observation of water containing specimens as they are with ordinary SEMs is one of the long desired goals of SEM. We have succeeded to observe a water droplet with a newly developed technique, Aqua Cover technique, with a commercial SEM, JSM-IT300LV. Aqua Cover, as you will see, can easily be extended to observe any water containing specimen.

SEM imaging condition for water in the liquid state

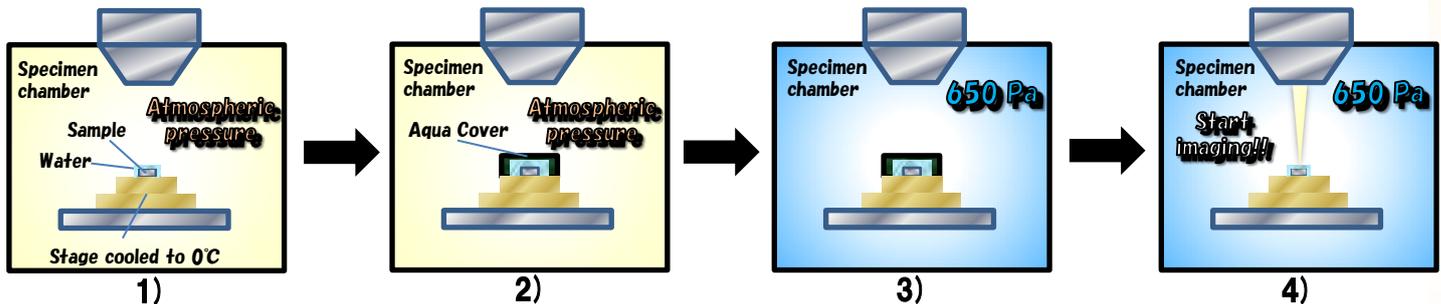
JSM-IT300LV is one of our representative SEMs to which the low vacuum system and cooling stage can be installed as options. In the low vacuum mode of JSM-IT300LV, the vacuum in the specimen chamber can be maintained at a pressure from 10 Pa to 650 Pa. DEBEN's Coolstage (UK) can keep the specimen temperature from -25 °C to +50 °C with a Peltier system.

The phase diagram of water is shown on the left. It shows that there is a water stable region where we can set the specimen in JSM-IT300LV; that is, in principle, however, to bring the specimen to this condition without changing the state needs a special technique. For instance, reducing pressure in the specimen chamber by evacuation makes the specimen, a water droplet, dehydrate and freeze due to adiabatic cooling, resulting in the disappearance of a water droplet on the supporting surface.

We have developed a new technique, Aqua Cover technique, with which we can consistently bring the specimen to the above temperature-pressure condition, maintaining water in the specimen. The procedure in this technique is described below. Once the condition is stabilized, we can observe the water containing specimen.



Procedure in Aqua Cover Technique



- 1) Place a water containing specimen onto the Coolstage while the specimen chamber is at the atmospheric pressure, set the temperature at 0 °C.
- 2) Put the Aqua Cover onto the specimen.
- 3) Evacuate the specimen chamber to 650 Pa.
- 4) When the vacuum is stabilized at 650 Pa, remove the Aqua Cover, and start observation.

Observation of a water droplet with Aqua Cover technique

The image on the right is a water droplet on a cloth surface acquired with Aqua Cover technique. The specimen was prepared by dribbling 0.5 μ l of water on a water repellent cloth specimen. Tilting the specimen by 45° makes it clear that the droplet is repelled by the surface.

Concluding remarks

In this note, direct observation of a water droplet is reported with Aqua Cover technique. This technique can easily be extended to observe water containing specimens and we are now successfully accumulating observation data on water containing specimens. One other thing to be emphasized is about our commercial SEM, JSM-IT300LV. It can maintain vacuum at a pressure up to 650 Pa with a newly designed low vacuum system. Besides, the probe current is optimized to produce images with a superior S/N ratio at vacuum levels up to 650 Pa.

Stereographic images with a deep depth of focus, one of the characteristic features of SEM, can also be acquired with this technique. Dynamic observation of processes involving water such as evaporation gives interesting subjects to be pursued.

