Images from Minne"Snow"ta

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When the workload is light, we like to hone our skills by performing analysis on difficult samples (or at least that's the justification for this particular diversion). During the long winter of 1996-97, we took up the challenge of imaging snowflakes using our scanning electron microscope (SEM). Snow, being both nonconductive and liquid at room temperature, provides some challenges to the microscopist.

We have a JEOL 5800LV, which when operating in "Low Vacuum" mode, can image nonconductive samples without charging. This is achieved by allowing a relatively high pressure in the sample chamber. The air in the chamber ionizes in the beam and neutralizes the charge buildup on the sample.

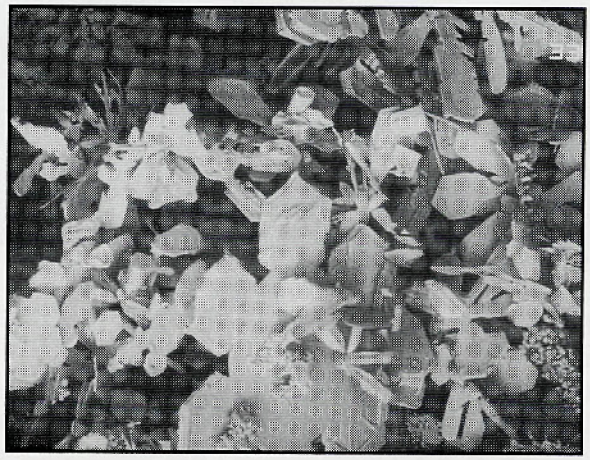
Our paying jobs are typically with solid materials, such as metal fractures and printed circuit boards, and we do not have a cryogenic stage. To keep the snow from melting, we pre-cooled the sample stage and worked quickly. Our first attempts yielded snow flakes covered in frost formed on the samples during their short trip through the warm lab from the outside.

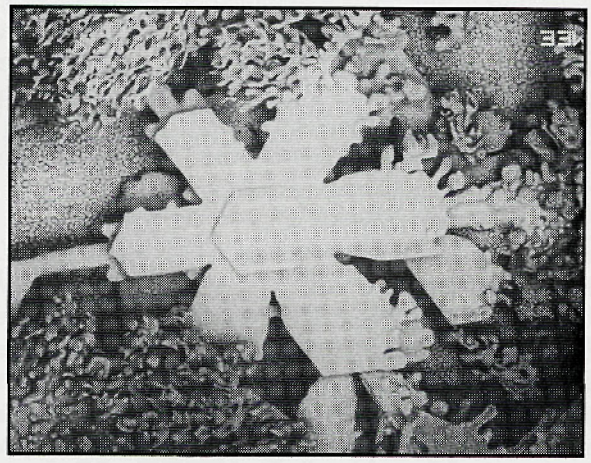
We found two methods to fight the frost. First, we chilled a 4-inch diameter aluminum sample holder in liquid nitrogen. The snow was captured on a 2-inch diameter thin piece aluminum, which was placed at the center of the larger holder. With this two-piece configuration, moisture in the warm room air in the laboratory condensed on the coldest area around the edge of the stage and minimized the amount of frost accumulation on the sample area.

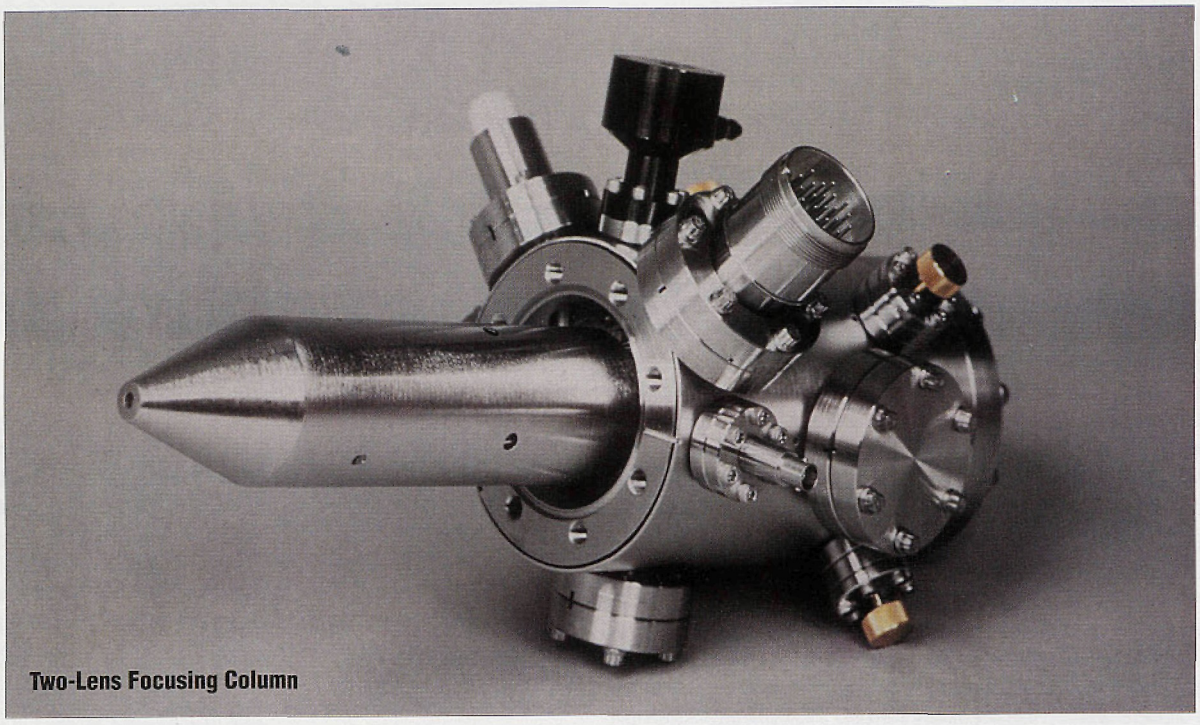
For the second method to eliminate frost, we created a shallow well in the sample holder. The snow was collected in this well and covered with enough liquid nitrogen to protect the flakes while exposed to the warm laboratory air. The last of the liquid nitrogen was boiled off as the vacuum was pulled on the SEM chamber. Both methods allowed us about 15 minutes for imaging the flakes before melt-down began.

Imaging was performed using backscattered electron imaging with an accelerating voltage of 30 keV. The high accelerating voltage was required because of the long working distance needed to achieve a low enough magnification to capture an entire snowflake. Digital SEM images were collected and some images were colonized using Paint Shop Pro image editing software.

The complexity and symmetry of the snow crystals are extremely fascinating and beautiful. The shapes that we have seen range from the classic fine-structured "flat" flakes to hexagonal columns. In addition to the images that accompany this article, we have posted a small collection of snow crystal images on our web site at http://www.mee-inc.com. We will continue our search to find two snowflakes that are exactly alike and will periodically post new images to the web site as we search.







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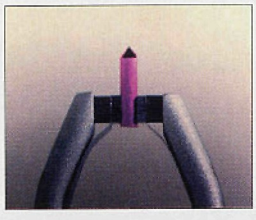

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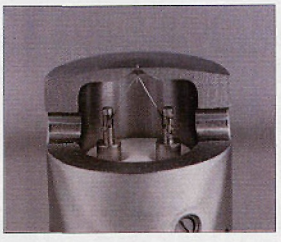

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