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Patterning of Ge nanoparticles by focused electron beam[1] NAN JIANG, Department of Physics, Arizona State University — We demonstrate that Ge nano-particles can be precipitated in GeO_2 and GeO_2-SiO_2 efficiently by the high-energy focused electron beam. The dynamic process of nanoparticle precipitations in these oxides were observed from the TEM images in real time, and analyzed using time-resolved electron energy loss spectroscopy (TREELS). The composition and structure of the precipitated nanoparticles were determined using both high-spatial resolution EELS and diffraction techniques. It was found that the particles are pure Ge and the average size increases slightly with the irradiation time. The dependences of size of nanoparticles on dose and dose rate of electron beam were also statistically analyzed, which is important to optimize experimental conditions to control the size of patterned nanoparticles. The mechanism involving the nucleation and growth process on surfaces is responsible for the precipitation of Ge in GeO_2. This was obtained through the thickness dependence of precipitation process. The patterned nanoparticles were then fabricated using the scanning (STEM) mode in a single step process. We noted that the production of Ge nano-particles using this method is impressively efficient; less than a second is needed to create a large assembly of nanoparticles simultaneously under parallel illumination mode in TEM. Using the focused electron probe, a single particles can be formed within several tens milliseconds.

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