Supplementary Document: Advancing Correlative Microscopy: In-Situ Integration of AFM-SEM-EDS for Multi-Modal Analysis

SEM, EDS, and AFM correlated images were obtained through in-situ measurements on an interlayer circuit via structure. The representation of the circuit is given in Figure-1 below.

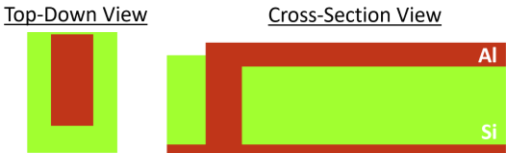

Figure 1 - The sample: the cross-section view of the VIA circuit (simplified)

EDS analysis is able to distinguish the aluminum path and the silicon substrate as well as the position of the aluminum via, i.e., the dense, red-colored region in the middle of the metal path (Fig. 2 - middle image). Also, there are slightly brighter green (= higher concentration) regions around the VIA. These show greater silicon concentration. This is expected since the aluminum path is thinner around the via (see AFM image). Consistently, a lesser amount of silicon signal is detected from the via region since the top material is aluminum in this region (see Fig. 2. - middle image).

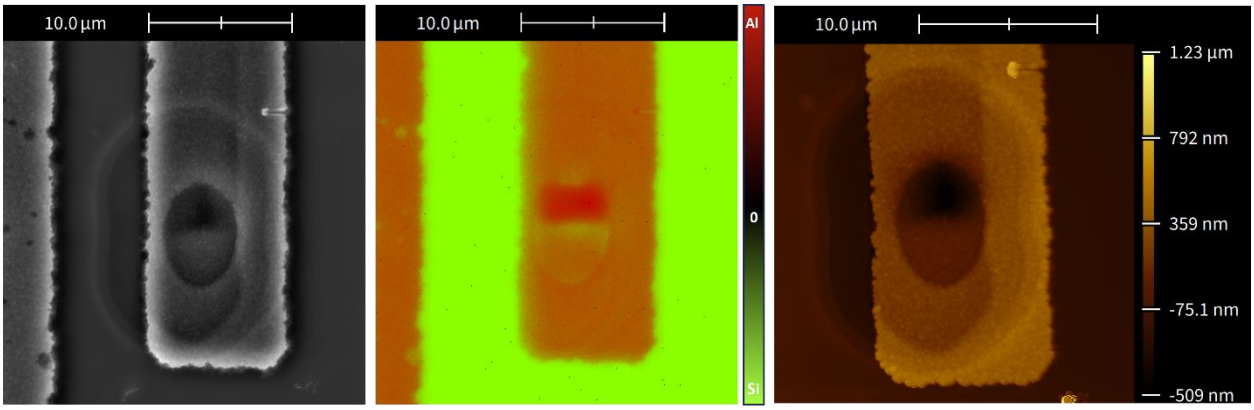

Figure 2 - SEM-SE, EDS X-ray (Al and Si are superimposed), and AFM-Topography (from left to right) images of the sample.

An AFM topography channel is correlated with the EDS channel in Figure – 3. The topography is represented in 3D, and the color scheme is adapted from the EDS channel.

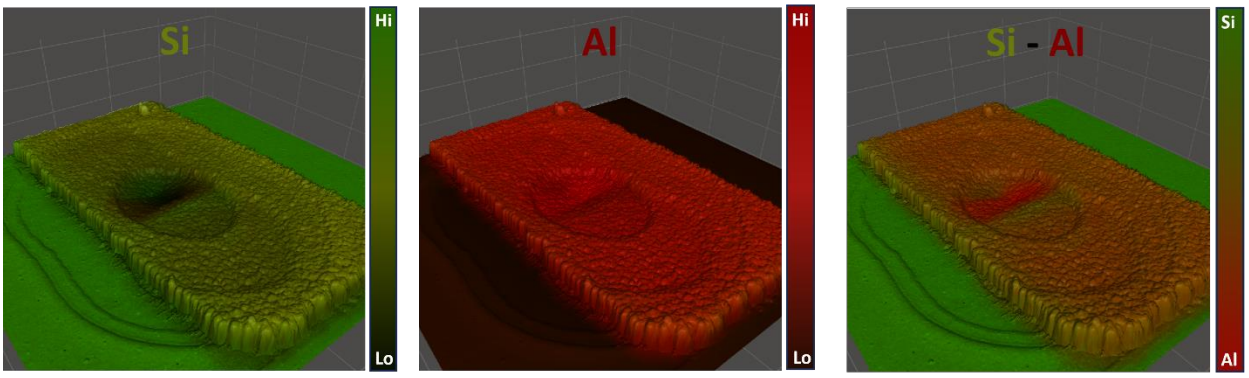

Figure 3 - Correlation of a 3D topography view with X-ray images shown in Figure - 2. The colors represent the material concentration instead of the height. On the left-hand side, only the Al channel is superimposed onto the 3D image; in the middle, only the Si channel is superimposed; and on the right-hand side, both Si and Al channels are superimposed onto a 3D representation of the AFM topography image.