A Comparison of Experimental EPMA Data and Monte Carlo Simulations

P. Carpenter, SD46 / BAE Systems / NASA, Marshall Space Flight Center, AL 35812, USA.

paul.carpenter@msfc.nasa.gov

Monte Carlo (MC) modeling shows excellent prospects for simulating electron scattering and x-ray emission from complex geometries, and can be compared to experimental measurements using electron-probe microanalysis (EPMA) and \( \phi(p_z) \) correction algorithms. Experimental EPMA measurements made on NIST SRM 481 (AgAu) and 482 (CuAu) alloys, at a range of accelerating potential and instrument take-off angles, represent a formal microanalysis data set that has been used to develop \( \phi(p_z) \) correction algorithms. The accuracy of MC calculations obtained using the NIST, WinCasino, WinXray, and Penelope MC packages will be evaluated relative to these experimental data. The \( \alpha \)-factor method has previously been used to evaluate systematic errors in the analysis of semiconductor and silicate minerals [1,2,3], and will be used here to compare the accuracy of experimental and calculated x-ray data. X-ray intensities calculated by MC are used to generate \( \alpha \)-factors using the certificated compositions in the CuAu binary relative to pure Cu and Au standards. MC-generated x-ray intensities have a "built-in" atomic number correction, and are further corrected for absorption and characteristic and continuum fluorescence by \( \phi(p_z) \) correction algorithms. Preliminary results for \( \alpha \)-factor analysis of Cu K\( \alpha \) in SRM 482 at 20 kV and 40 degree takeoff angle are shown in figure 1. For these data there is ~ 5% agreement between intensities calculated by MC and the PAP \( \phi(p_z) \) algorithm compared to experimental EPMA data acquired from three different instruments. This excellent agreement indicates that MC modeling can be successfully used to calculate x-ray intensities for quantitative EPMA.

References