A widely used approach to interconnect prototype circuits and to rewire defective circuits is direct writing of metal lines at the backend of the process line by means of focused ion beam (FIB) induced deposition. In this work we investigate the focused ion beam induced chemical vapor deposition process of tungsten focusing on nucleation at the early stages of the formation process, the formation of a contiguous interface, and finally the linear growth. The study involves in situ characterization of the evolving layer surface employing FIB-secondary electron microscope (FIB-SEM) imaging. For the experimental studies of the focused ion beam induced tungsten deposition, a Micron FIB-2500 system is used operating with a gallium liquid metal ion source. The Ga+ ions are extracted from a small local region of a gallium droplet and then collimated and focused to an ion beam by an electrostatic lens arrangement. A total acceleration voltage of 50 kV is applied between the ion source and the substrate surfaces and decompose during ion beam exposure to an accumulated ion dose of about 0.25 nC/µm2 (1.56 × 1017 ions/cm2), the merging process causing the individual boundaries of former separated regions to vanish the principal shapes of the structures are not destroyed by the ion beam. After a contiguous tungsten layer has formed on the SiO2 surface, the further deposition process is characterized by homological growth of tungsten on a tungsten surface and the thickness of deposited metal correlates linear with the total ion dose. In a further step the impact of the average current density \( j \) on the deposition yield was determined using tungsten films deposited on a tungsten surface. In order to give a concise interpretation of the experimental findings a simple analytic model describing the deposition process is used. \(^2\) In Fig. 2, the atomic deposition yield \( Y_A \) determined by experiments is plotted versus the average ion current density. The negative yield values correspond to conditions where the sputter effect of the ions exceeds the ion induced deposition. \( Y_S \) is the sputter yield, \( \Phi \) the precursor gas flux and \( \sigma_0 \) the asymptotic yield at \( j=0 \).

The solid line in Fig. 2 represents a fit of the model to the data.

\[
Y_A = \sigma_0 - j \Phi / \sigma_S
\]

The critical ion current density \( J_0 \) where ion sputtering exceeds deposition was identified by the model. Because the model shows good agreement with the measurement it should be suitable for further survey concerning FIB process development.