Dimensional characterization of waveguide coupling device structures fabricated by the Fixed Beam Moving Stage (FBMS) electron beam lithography

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The Fixed Beam Moving Stage (FBMS) lithography mode is a feature of Raith electron beam and ion beam lithography systems that is unique among Gaussian, vector scanning lithography systems commercially available. FBMS is a zero stitching error writing strategy that is capable of creating extremely long, smooth, and continuous lines of arbitrary curvature. The resulting FBMS lines have small linewidth variance and are free of the stitching errors found in traditional vector scanning, stage stepping electron beam lithography systems. The FBMS lithography mode is therefore the mode of choice for long waveguide fabrication.

We present the application of FBMS on the Raith *e_LiNE* electron beam lithography system towards the fabrication of waveguide coupling device structures (Figure 1). One major challenge in the fabrication of such structures is controlling the relative positions and dimensions of the exposed structures: the gap width between the straight waveguide and the resonator ring, as well as the line widths of these structures, must be fabricated reliably in order to obtain the desired optical behavior of the intended nanophotonic device. The *e_LiNE* system's electron microscopy metrology toolset is used to perform dimensional characterization on the resulting FBMS waveguide structures (Figure 2). These results (Figure 3) serve as a benchmark for the FBMS lithography mode on the Raith *e_LiNE* system, and similar results are anticipated for FBMS on other Raith electron beam and ion beam lithography systems.

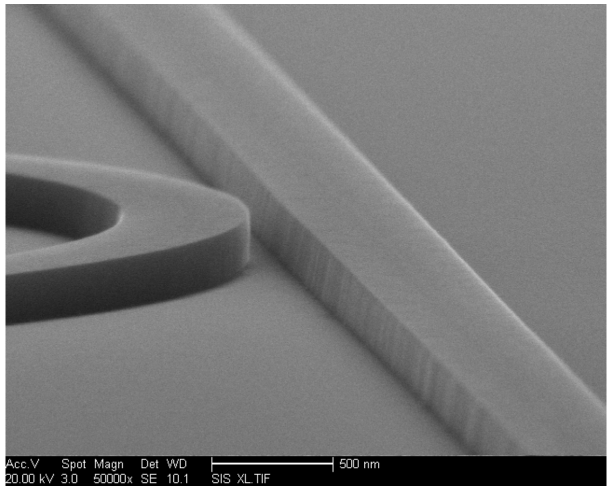

Figure 1 An example of a waveguide coupling device. Scale bar is 500 nm. Courtesy of Linjie Zhou, Katsunari Okamoto, and S. J. Ben Yoo, University of California Davis, and James Conway, Stanford Nanofabrication Facility**.**

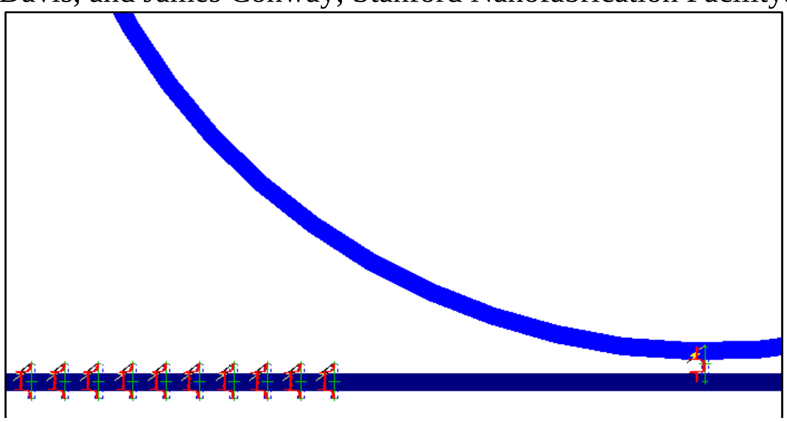

Figure 2 Dimensional measurements overlaid on GDSII design of waveguide coupling device structure.

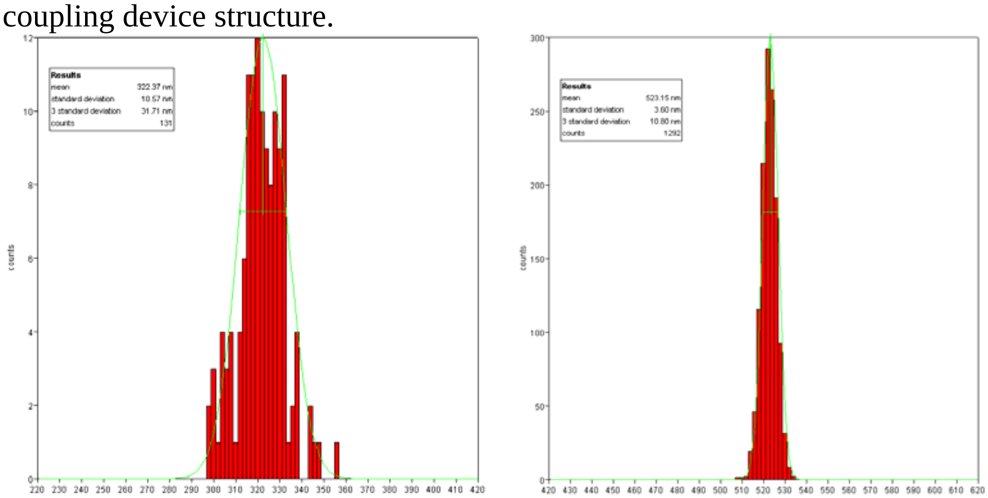

Figure 3 Left: The gap width distribution for an array of identical waveguide device structures is 32nm (3σ). Right: The line width distribution for an array of identical waveguide devices structures is 11nm (3σ).