

Supporting Information

Controlled Morphological Bending of 3D-FEBID Structures via Electron Beam Curing

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Supplement S1: Point Pitch and Dwell Time variation

To test the influence of the step size within the electron beam curing (EBC) irradiation grid (point pitch **PoP**) and the dwell time splitting for each patterning pass (dwell time **DT**), an experimental series was conducted. $W \times H \times T = (1000 \times 2000 \times 100)$ nm vertical FEBID walls were used as base elements, which were EBC treated via horizontal patterning strips of $W \times H = (1200 \times 200)$ nm size under a sample tilt angle of 52° . Fig. S1 shows the results for bending angles β in dependency on PoP for two different dwell times $DT = 1$ ms (green) and $DT = 100$ μ s (blue). All curing processes were performed at 2 keV primary electron energy, 48 pA primary electron current and irradiation doses of ≈ 8 C/cm². The average difference in bending angles between $DT = 1$ ms and $DT = 100$ μ s is $\Delta\beta \approx 0.1^\circ$ and can therefore be neglected. For further EBC experiments, 1 ms was used as the standard dwell time. For point pitches between 5 nm and 50 nm, a minor increase in bending angles was observed, although with a limited impact of $\Delta\beta \approx 1^\circ$. As the point pitch only seems to play an insignificant role concerning the efficiency of EBC, 5 nm were chosen as the standard parameter as, from an optical point of view, this value provided the smoothest fold with the least indentations at curing sites.

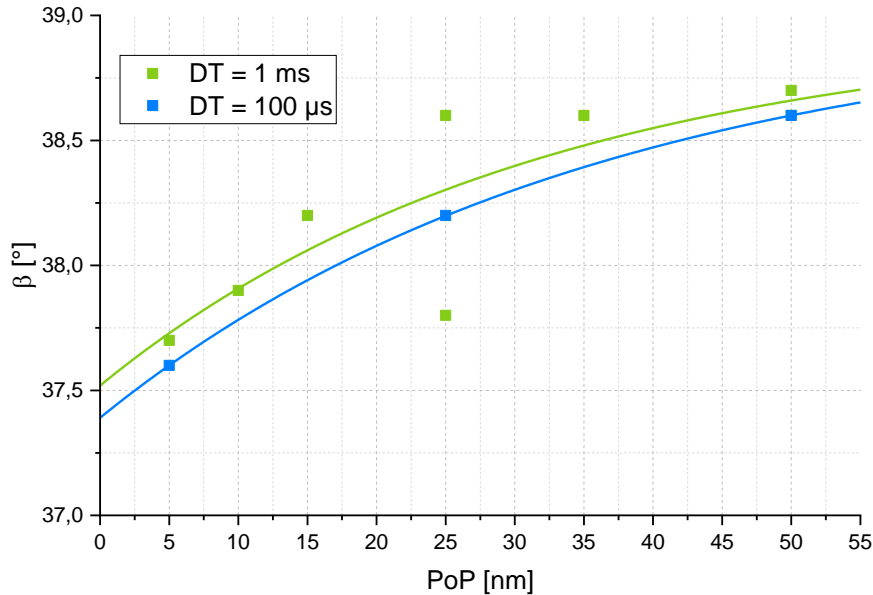


Figure S1: Impact of point pitch PoP and dwell time DT on EBC efficiency. Bending angles β are depicted depending on PoP for two different dwell times of $DT = 1$ ms (green) and $DT = 100$ μ s (blue).

Supplement S2: Width Variation

To show the applicability of this targeted bending method via EBC to elements of different dimensions, a series of walls with varying widths was deposited via FEBID and electron beam cured at 2 keV and 48 pA with irradiation doses of $\approx 8 \text{ C/cm}^2$ as illustrated in Fig. S2. The bending angles showed deviations of up to 5° , but a significant trend could not yet be discerned from the experimental data. We do, however, expect a more detailed insight into possible differences in the effectivity of the bending behaviour depending on the element width from ongoing investigations.

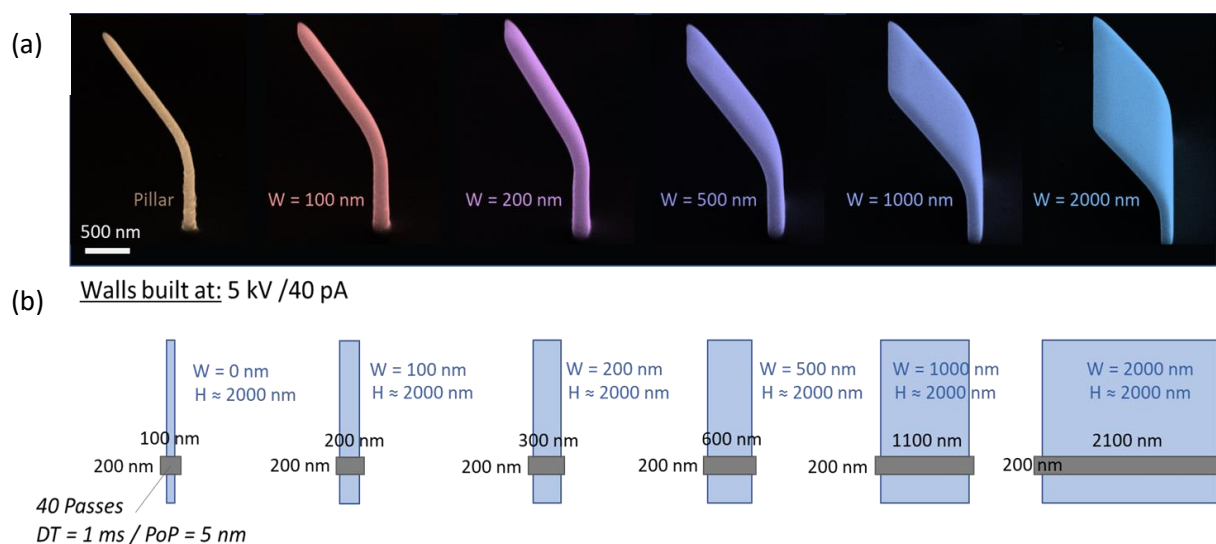


Figure S2: Electron beam cured walls of different widths. (a) SEM images of bent walls from point deposition (left) to width $W = 2 \mu\text{m}$ (right) in a side view and (b) schematics of the used EBC patterns, with base element walls in blue and electron beam cured areas in grey.